Unravelling the fabric

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Unravelling the Fabric
Textile Production in Iron Age Transjordan

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I dedicate this work to my late husband Jan J. Noorda

From the moment Eve realized that she and Adam were naked, mankind was destined to spin and weave[1]

Foreword and acknowledgements

My fascination for textiles in archaeology started when I joined the excavations at Deir Alla as a student, in 1996, and found two rows of loom weights in situ. The presence of the weights was exciting because they represented a loom standing there long ago, the loom weights still on the spot where they fell from the loom when a fire destroyed the settlement, around 800 BC. I discovered fingerprints left behind in the wet clay of the loom weights and realized how little we know about the lives of the people making the loom weights, the weavers and their products in Levantine archaeology. I decided then to study these loom weights and research textile production in Iron Age Transjordan.

The vivid and interesting lessons on archaeological textiles by Gillian Vogelsang-Eastwood in Leiden led me to read her 1989 article on textile and textile production tools from Deir Alla. The large number of loom weights recovered at Tell Deir Alla phase IX, from sealed loci and recorded with their stratigraphical contexts, in combination with the find of a fragment of hempen cloth from the same period, provided a solid base for my research. While working on the loom weights and studying literature on this subject from Israel and Europe, I realized that the typology of loom weights was opaque. I decided to perform a simulation experiment in order to understand the production processes of the different shapes of loom weights. This experiment formed part of an earlier thesis on the Deir Alla weaving materials, submitted to Leiden University in 1999, and published as an article in ADAJ in 2004. At the excavations in Deir Alla I learned to dig stratigraphically. I thank Gerrit van der Kooij who taught me so much about the archaeology of the southern Levant and who offered me the opportunity to study the loom weights of Deir Alla phase IX.

In 2001 I was given access to several more collections of loom weights from different Iron Age sites in Jordan, and I intended to use my research on the loom weights from Deir Alla as a pilot study to reconstruct textile production in Iron Age Jordan. In the same year, Michele Daviau asked me to study the loom weights and textiles from Khirbet al-Mudayna. She invited me to Mudayna to join the excavations, to identify and study the artefacts associated with textile production, allowing me to include material from Iron Age Moab. I studied all the loom weights excavated at Mudayna between 1996 and 2009 and I want to thank Michele Daviau for the opportunity she gave me to work with her material. During the visits to Jordan I was always glad to find Noor Mulder at the excavations of Mudayna, her friendship and support were a great help.

In October 2001 Gillian Vogelsang invited me to attend the colloquia organized by the Abegg Stiftung in Rigisberg, Switzerland, to meet people involved in textile studies. There I met Lise Bender Jørgensen, Ulla Mannering and John Peter Wild, whose lectures and publications helped me to understand archaeological textiles, and Orit Shamir who helped me establish contacts in the field of archaeological textiles in Israel.

Catching up on the art of weaving with Agnes Feij was a great pleasure and enabled me to understand the different techniques. While studying the literature on textile production in Scandinavia, I realized that I could not understand how tablet weaving was performed from descriptions only. I learned the technique from a specialist. Marijke van Epen and her tablet-weaving group associated with Archeon (Alphen aan de Rijn) were kind enough to teach me how to weave coloured bands using tablets.

[1] After E.W. Barber. Women's Work; The First 20,000 Years. 1994: 252.

In 2005 Eveline Van der Steen invited me to study the loom weights from Tell Mazar. Located so close to Deir Alla and with loom weights from different periods, Tell Mazar offered the chance to compare its loom weights to those of Tell Deir Alla and to design a chronological typology for loom weights. Here I want to thank Maysoon al-Nahar, Director of the University of Jordan Archaeological Museum in Amman, and Muath al-Fuqaha, curator of the museum, who kindly facilitated my research on the loom weights. Eveline van der Steen inspired me with her knowledge of Levantine archaeology and helped me to realize my research.
When Nancy Lapp asked me in 2008 to look at her material from Tell er-Rumeith, in the hill country of Gilead, I welcomed the opportunity to study this interesting collection of different artefacts possibly used in textile production. It was a chance to add Iron Age IIA loom weights to my research. Because the quantity of tools was small I had to come up with a different way of interpreting the finds. The different tools used in textile production made it possible to study the differences in the use of raw materials between the hill country, the Jordan Valley and Moab. The finds from Rumeith were used in a small pilot study, investigating whether loom weights and spindle whorls from one site can specify what kind of raw fibre was used to make the textiles.
Two more articles on the interpretation of the textile finds and loom weights from Deir Alla were published, in 2007 and 2008. The simulation experiment, the technical research on which my typology of loom weights is based, was modified continuously whilst I studied the material. The new results were published in 2009 in the *Leiden Journal of Pottery Studies*. Also in 2009 an article on the development and geographical spread of the warp-weighted loom appeared in *Studies in the History and Archaeology of Jordan*. The first part of this thesis was conducted under the supervision of Gerrit van der Kooij of Leiden University.

I am very grateful to Professors Mladen Popović and Ed Noort, who supervised the last stages of my research and who encouraged me to continue my research and write this book. And here I would like to express many thanks to Mladen and Ed who had the fantastic idea to invite Orit Shamir as a specialist on textiles to join the assessment committee for my dissertation. Because I could not mention her name on the back of the front page, I would like to say thanks to Orit here for adding valuable comments to my research.

A special word of thanks goes to Margreet Steiner who inspired and supported my research. As a friend and colleague she walked next to me on the long way to completing this book.
I want to express gratitude to members of the Deir Alla team who inspired me: Eveline van der Steen, whose analytical questions and inspiring enthusiasm opened up my mind and led me into modern archaeological research; Lucas Petit who showed me how to excavate in mud brick; Xander Veldhuizen with his surprising ideas about archaeology; Hugo de Reede for his drawings of the loom weights of Deir Alla. My thanks go to Loe Jacobs and Bram van As who came to Jordan to sample the clay in the Wadi ath-Thamad and helped me with fabric studies of the loom weights from Khirbet al-Mudayna.
I would like to thank Ross Loyd and Julia Harvey for their invaluable help in correcting my English and removing the Dutchisms. Again my thanks goes to Eveline van der Steen, this time for making the maps for this publication. A word of thanks goes to Geirthrudur Finnbogadottir Hjorvar who made the picture used on the cover of this book.

I am also grateful for support from my children Itamar, Ruchama, Hadassa and Jonathan, each in his or her own way helped me to complete this study. My father Maas Boertien was the one who triggered my interest in archaeology. He took my brothers and me as teenagers to excavations in Israel and Jordan and showed us around the museums, sharing his fascination for archaeology with us. Later, when I was one of his students of Semitics, he taught me how fascinating research can be.

This book should be regarded as a starting point for textile research in Iron Age Transjordan. Iron Age archaeology in Jordan does not supply enough information and lacks sufficient excavated material to draw a complete picture of textile production in the entire Iron Age. Therefore this study will be limited to Iron Age IIB until the Persian period (Iron Age III). Hopefully, I will be able to study the remaining excavated loom weights from the Late Bronze Age, Early Iron Age and the Persian Period of Deir Alla, and the spindle whorls of Deir Alla and Tell Mazar, in order to create a more complete picture for the Jordan Valley in the future.

My interest in, and the relevance and importance of textiles in archaeology inspired me to write this book. Textiles are very personal to us, as they were in earlier times. Textiles are used as clothing items for everyday and special use and as part of the fabric of shelter. This gives them an emotional value and opens up the possibility to learn about how people living in the southern Levant organized their daily lives; what their ideas about textiles were and the roles they played in their everyday lives and society. From there it will be possible to make some remarks on the use of textiles in a cultic context in the region under study.

I hope, through my partial painting of a picture of the manufacture and use of textiles, to inspire others to appreciate their relevance to archaeological studies. There are large amounts of materials waiting to be studied. Although they look unprepossessing, they offer a unique chance to lift a veil on unknown chapters of Iron Age Transjordan.

Leiden, October 2013

The Iona Stichting (Amsterdam), Stichting Thomas More, Stichting Fonds Catharine van Tussenbroek, NWO (the Netherlands Organisation for Scientific Research), the White-Levy fund, the Wadi ath-Thamad Project and my mother Henny Boertien-van der Kolk generously contributed to my research, making it possible to complete this book.

PART ONE

The Threads – Tracing textiles and textile production in the Southern Levant

Chapter 1 Introduction

Textile industry is older than pottery making and perhaps even than agriculture and stock breeding, and it probably consumed far more hours of labour than pottery making and food production together. (Barber 1991:4).

Textiles were and remain an essential part of life. Knowing which fibre was spun and what kind of cloth was woven can give us clues about how a society organized its agriculture, herding, economic structure and social relationships, and sometimes opens a window into religion and the practice of religious belief. The aim of my research is to help understand textile production in Iron Age Transjordan.

1.1 Research objectives

It is possible to study the economy of a given period by studying the remains of textile production. According to Braudel, textile production in fact implied the organization of the whole economy and society (Braudel 2002:73). The production of textiles was labour-intensive and involved processes such as the mobilization of agricultural resources, preparation of raw materials, skilled manufacturing, storage and distribution, all of which functioned within a specific socioeconomic system. This study aims to add systematic research of textile production to the archaeology of this region as a source of information for the study of the economy of Iron Age Transjordan.

The objectives of my research are to assemble archaeological evidence of textile production in Iron Age Transjordan, to draw a coherent picture of the production, organization and consumption (use) of textiles. Because only very few yarns and textiles survive, research on textile production has to focus on artefacts used to produce the textiles. Tools used to produce the fabrics include spindles and looms, together with some other artefacts needed in the production process, such as needles and spatulas. Spindles consist of a shaft and a spindle whorl. The shaft is usually made of wood and decays over time. Spindle whorls, however, are made of stone or pottery and thus have survived. The study of spindle whorls adds valuable information about the kind of fibre produced, but it is not the first choice when reconstructing textile production. Spinning is only part of the process of textile production and the problem with spinning is that it can be performed anywhere, making it difficult to know which part of the production process is represented by the whorls found at a site.

Reconstruction of textile production requires the cloth or the loom on which it was woven. Because looms were made of wood they have mostly not survived in recognizable shapes. But in the Levantine Iron Ages there were prominent artefacts used in the weaving process that have survived and thus enable us to reconstruct part of the production process: loom weights. Loom weights are used to stretch the warp threads on a warp-weighted loom.

Iron Age loom weights were usually made of clay, making the warp-weighted loom recognizable in the archaeological record. During the Iron Ages the numbers of loom weights increase considerably, indicating that the warp-weighted loom was used intensively, although the warp-weighted loom was not the only kind of loom used to make cloth.

Over 1480 loom weights from four Iron Age sites provided the basic information for my study of textile production in Transjordan. The first step in studying excavated material was tracing Iron Age loom weights from Transjordan. Many colleagues excavating were kind enough to let me study their perforated clay balls. Because loom weights are heavy, a location nearby the storage facilities had to be found where the dusty clay weights could be studied. At this stage in the research three major collections were studied: Tell Deir Alla, Tell Mazar and Khirbet al-Mudayna. Each collection of loom weights has been studied separately. The loom weights were 'exhibited' on tables to get a general overview of the material. A standardized form was used to register the different aspects of each loom weight (Appendix I). Each loom weight was registered and the perforation of the loom weight carefully cleaned. Material from inside the perforation was analyzed using a magnifying glass in order not to miss fragments of yarn. The loom weight was weighed and measured (diameter and height). The shape of the perforation was analyzed and registered together with the diameter. The clay and temper were analyzed using a microscope (magnification x10), and registered. The type of loom weight was described. Signs of wear, owners marks and traces of manufacturing were registered, drawn and photographed. Drawings and photographs were made of the different types of loom weights, and groups of loom weights from the same square and locus were photographed together as a group. Data from each excavation were processed and the database used to interpret and compare finds from different excavations. After studying the stratigraphy and excavation reports, the large groups of loom weights (> 10 ex.) representing a loom could be plotted on plans. If textiles and/or other materials associated with textile production were available for study, then they were analyzed, photographed, drawn and registered. Finally, the finds could be interpreted and compared to the material published by colleagues resulting in the reports in chapter 6-8. The material from Tell er-Rumeith was studied in a different way because the artefacts were already registered. I saw the artefacts and the data were kindly shared.

The loom weights from Tell Mazar and Tell Deir Alla, both situated in the Jordan Valley, offered a chance to concentrate some research on the kinds of raw materials used in the late Iron Age. The material from Tell er-Rumeith provided information on spindle whorls and spatulas in combination with loom weights. Two sites, Tell Deir Alla and Khirbet al-Mudayna, also yielded textile fragments, adding unique information to this study. Khirbet al-Mudayna yielded architectural features and other artefacts associated with textile production, such as spindle whorls, bone spatulas, and basins. The loom weights from Tell Mazar were found in different strata. Tell Mazar is the first site to provide a diachronic overview of loom weights in Transjordan. In combination with the finds from other sites and an experiment in making loom weights, the study of the objects from these four sites made it possible to design a loom weight typology for Transjordan.
The results from the study of the artefacts and the textiles provided a framework for the reconstruction of textile production to which information from experimental archaeology could be added, while textual material provided a link to the ideology and beliefs of the Iron Age.

1.2 The structure of this book

The book is divided into three main parts; each title refers to the part of the process in which it contributes to unravelling the fabric of textile production in Transjordan.

Part one: The threads - Tracing textiles and textile production in the Southern Levant provides a general introduction to textile production in the southern Levant. The first chapter provides an introduction to the terminology and research history in the field of textile research in the region. A historical sketch of the Southern Levant frames the finds that will be discussed in the following chapters. Finally, the question of whether or not textile production increased as a result of Assyrian tributary demands is discussed. In chapter 2 the different kinds of raw materials from which the threads were made are discussed. General information on weft and cloth is provided; colour and dying techniques are discussed and the dyes used in the Levant are listed. Chapter 3 provides an overview of the kinds of looms used in antiquity and focuses on the origin and spread of the innovative warp-weighted loom that could be used to make patterned weft. Originally from central Europe this weaving technique travelled via Italy, Greece and Anatolia and reached the Levant in the Bronze Age. The use of loom weights, a characteristic of the warp-weighted loom, grew during the Iron Ages and resulted in the famous Levantine weaving tradition. In this chapter I will introduce different kinds of weaving and the looms used in antiquity. This will demonstrate how an innovation in weaving, the flexible hanging kind of loom originally from central Europe, spread via Italy, Greece and Anatolia into the Levant. The loom was meant to make patterned weft, and some of the tools used in the production will be discussed. Chapter 4 explains how loom weights, remnants of the warp-weighted loom, can be used as a research tool to reconstruct textile production. A simulation experiment in the context of a technological study of Levantine Iron Age clay loom weights was performed to find out how different types of loom weights were made. The results of this experiment form the technical basis for the loom weight typology proposed in chapter 10. Chapter 5 gives a historical overview of the loom weights excavated in the Levant.

Part two: Research – Unravelling the finds concerns research on the loom weights and other tools used in textile production from four different sites in Transjordan. The sites under study are Tell Deir Alla (Chapter 6) and Tell Mazar (Chapter 7) both situated in the Jordan Valley; Khirbet al-Mudayna in Moab (Chapter 8) and Tell er-Rumeith in the hill country of Gilead (Chapter 9). The loom weights from these sites were studied and compared. Textile fragments found at Deir Alla and the textiles and textile imprints from Khirbet al-Mudayna are presented and discussed in Chapters 6 and 8. The appendix to Chapter 6 investigates the question of whether fibre hemp could have been grown in the Jordan Valley, and, inspired by the Gezer Calendar, an agricultural calendar is designed for Iron Age Deir Alla. In Chapter 7 the loom weights from different strata of Tell Mazar are studied diachronically, enabling construction of a chronological framework for the typology of loom weights from Transjordan. In Chapter 8 the loom weights of Khirbet al-Mudayna are studied in context with the architecture and other finds associated with textile production. And in Chapter 9 all the artefacts used for textile production excavated at Tell er-Rumeith are presented and studied comparatively.

In *Part three: Interweaving the facts* the unravelled facts are interwoven and the conclusions and interpretations are presented. In Chapter 10 the research objectives are achieved and loom weights from the four sites are used to design a typology of Transjordanian clay loom weights. The clay and temper of loom weights from Deir Alla and Khirbet al-Mudayna is studied and will be compared to the fabric of pottery from both sites. Regional differences between loom weights from the Jordan Valley and those from the hill countries of Gilead and Moab will be discussed. Ammonite loom weights appear to be different in some aspects from those from Moab, Israel and Judah. In Chapter 11 the organization and distribution of textiles is investigated and a model for the study of textile production and trade is introduced. Finally, by applying this model to sites in Iron Age Transjordan, an outline can be sketched of the organization and output of the textile industry. Chapter 12 considers the possible connection between cult and textile production, based on archaeological and textual remains. In this chapter I will introduce some theories and indicators to distinguish cultic elements in archaeology. The theoretical framework will be fleshed out with two case studies from the sites Khirbet al-Mudayna and Deir Alla phase IX. The Khirbet al-Mudayna weaving and spinning implements, as well as the dyeing installations, have only been found in public areas and not in domestic contexts, demonstrating that production of textiles was probably meant for public use or profit. However the quantities produced at the site are very small, suggesting some kind of communal use within the enclosure. Weaving for a temple, and especially weaving clothes for a deity, is a well-known phenomenon in the ancient Near East; in the first section of this chapter I will investigate whether traces of such activities can be found at Khirbet al-Mudayna ath-Thamad. Some authors suggest a relationship between spinning and weaving and the goddess Asherah. In the second part of chapter 12, finds associated with textile production and texts found at Deir Alla phase IX and Kuntillet Ajrud will be studied and compared to investigate whether the finds illustrate this practice. Finally, in the epilogue the time factor in textile production will be explored.

1.3. Terminology and periodization

A short introduction will be given to the explicit terminology concerning geography, archaeology and textile research, followed by the historical periodization used in this book.

Geography

Certain terminology concerning geography and regional phenomena will be discussed here in brief, in order to clarify the historical, political and social contexts in the region under study.

Levant: Historically, the eastern part of the Mediterranean.
The Northern Levant includes the modern states of Syria, Lebanon and Cyprus.
The Southern Levant represents the area of ancient Canaan, including the modern states of Israel, Jordan and the Palestinian Territories, Gaza and the Sinai Peninsula.
The most prominent topographical feature of the Southern Levant is the Jordan Valley. This valley represents a huge geographical fault line, which is prominent also in Lebanon where it creates the Beqa Valley, continues southward to form the Red Sea, and extends as far as Mozambique in southern East Afric.

Transjordan. The prefix 'trans' refers to the land on the other side of the river Jordan. The equivalent term for the west side is the Cisjordan, literally 'on this side of the river Jordan'.[2]
The words *Transjordan and Cisjordan* – though historically a remnant of a western European point of view – are used here to distinguish between the western part of the Southern Levant (present-day Israel, the Palestinian Territories, Gaza and the Sinai peninsula) and the eastern part (Jordan). The natural borders between Transjordan and Cisjordan are the river Jordan, the Dead Sea and the Wadi Arabah as far as the Gulf of Aqabah/Elat.

Palestine is the more modern form of the name Philistia. The origin of this word lies in 'Pelešeth'. This is a name appearing frequently in the Hebrew Bible and known as 'Philistine' in English.
Philistia was located on the southwestern coastal strip of ancient Canaan, situated on the route between Asia and Africa. The inhabitants, the Philistines, are regarded as one of the Sea Peoples.[3]
Remains of Philistine material culture are found in the southern coastal plain in Gat, Ekron, Ashdod, Ashkelon and Gaza. In the 5th century BC, the Greek historian Herodotus was the first to use the term Palestine (*district of Syria Palaistinê*) referring to the area between Phoenicia and Egypt, including the Judean mountains and the Jordan Valley. The term was first used to denote an official province in *c*.135 AD, when the Roman emperor Hadrian, following the suppression of the Bar Kochba Revolt (132–135 AD), combined Judea (Iudaea) with Samaria, Galilea and Idumea into *Syria Palaestina*, and changed the name of Jerusalem to Colonia Aelia Capitolina in an attempt to erase the historical ties of the Jewish people to the region (Ben-Sasson 1976:334).
During the Byzantine period the entire region (Syria Palestina, Samaria and Galilee) was named *Palaestina*, subdivided into the provinces Palaestina I and II. The Byzantines renamed an area of land including the Negev and the Sinai as *Palaestina Salutaris*, sometimes called *Palaestina.* According to the historian Ben-Sasson, under Diocletian (284-305 AD) the region was divided into *Palaestina Prima,* which comprised Judea, Samaria, Idumea, Peraea and the coastal plain, with Caesarea as its capital, *Palaestina Secunda,* which consisted of Galilea, the Decapolis and the Golan, with Beth-Shean as its capital, and *Palaestina Tertia,* which was the Negev, with Petra as the capital (1976:351).
In English the geographical name *Palestine* is used to describe the region between the eastern Mediterranean Sea and the River Jordan, and various adjoining lands. It became more common after the European Renaissance. The name Palestine was officially revived by the British after the fall of the Ottoman Empire and applied to the territory that was placed under the Palestine Mandate. The boundaries of the region have changed over time, and were first defined by the Franco-British boundary agreement in 1920 and again in the Transjordan memorandum in 1922.

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[2] In ancient Hebrew there is no general term for the Transjordan, the general expression is *be'ever ha-jarden*, *beyond the Jordan*, occurring for example in Joshua 1:14. In Deut.3:25, 11:20 and Joz.24:8, however, the orientation is from east to west. Transjordan is an expression that was used by people on the west side of the Jordan, including most of the biblical writers. For the position of Transjordan in the Hebrew Bible see Noort 1987.

[3] For a complete overview of the texts on the Sea Peoples, the Philistines and their history see E. Noort 1994 and A. Yasur-Landau 2010.

For a long period of time *Palestinian archaeology* was the commonly accepted term referring to the archaeology of Cisjordan, Transjordan and the Sinai. Since the word Palestine now has a political meaning, it cannot be used in that way anymore; the archaeology in this region is now commonly called *archaeology of the Southern Levant*. The term *biblical archaeology*, originally almost synonymous with *Palestinian archaeology*, is limited in time and view and therefore will not be used here.

Middle East and/or Near East
Before and during the First World War the term *Near East* comprised Turkey, the Balkans, the Levant and Egypt and was in common use. The Near East was viewed in contrast to the Far East, i.e. China, Japan, Vietnam, etc. It is a relative term, invented by Europeans.
The term *Middle East* arose around the middle of the 19th century, when the 'nearest east' was considered to consist of Egypt, while the lands a little further east (Arabia, the Gulf, Persia (Iran) / Mesopotamia (Iraq) and Afghanistan) were thought to be in the *middle* between Egypt and the Far East. Originally the term *Near East* was almost synonymous with Egypt, but after the Second World War the term *Middle East* gradually also came to encompass Egypt.
Alternative terms for Middle East have been suggested, one of which is *West Asia* but this has the disadvantage of excluding Egypt. According to Mansfield (2004:1) the term Middle East is likely to continue to be in use for some time.
Though Eurocentric and embarrassing, especially from an archaeological perspective, due to a lack of alternatives the terms Near East and Middle East will be used in this book.
The *Ancient Near East* is a term used in Near Eastern archaeology and history. It comprises Mesopotamia (modern Iraq, southeast Turkey and northeastern Syria) ancient Egypt (although the majority of Egypt is geographically in northeastern Africa), ancient Iran (Elam, Media Parthia and Persia) Anatolia (modern Turkey) the Levant (modern Syria, Lebanon, Israel, Palestine and Jordan), Malta and the Arabian Peninsula.

A *tell (tel)* is an artificial mound formed by superimposed layers of ruined settlements. Geographical names referring to such a mound are written as Tell or Tel depending on their original nomenclature. Originally Arabic names are usually written as Tell and those originally Hebrew as Tel.

Archaeology
Words with a determinate meaning used within archaeological research will be introduced here in brief.
The terms *phase* and *stratum* refer to the period of use of a site. *Stratigraphy* is the sequence of superimposed layers present at an archaeological site, which have been formed through human action and natural processes.
In archaeology the terms fabric, clay/clays, temper and levigation are used to identify certain components of pottery and/or pottery production. *Clays* are complex materials found as sedimentary deposits, the result of the processes of fragmentation and/or chemical weathering of rocks and minerals that constitute the earth's crust. *Temper* is a substance added to clay, modifying its properties when wet or dry, during or after firing. *Levigation is* the process of purifying a clay deposit. The mined clay is mixed with water to let the coarser and heavier clay particles sink down in order to be removed. The water with suspended fine clay is subsequently kept and after evaporation the fine clay is ready to be used.
Fabric is generally speaking defined as manufactured material; the word *fabric* can be used for the essential structure of anything. Fabric can be used for cloth, typically produced by weaving or knitting textile fibres. It can also be used to describe the body of a fired vessel, which encompasses the fired clay matrix as well as the inclusions in it. Figuratively the term can also be used to describe the structure of a society or culture; 'the fabric of society'.
The words *textile*, *cloth* and *fabric* are used to describe a woven (interlaced, warp-weft) or non-woven piece of manufactured material, meant for use in clothing, hangings, coverings and

wrappings (after Burnham 1980, Emery 1966 and Vogelsang-Eastwood 1993). Although the technique of weaving textiles probably originated from the art of basketry, it is better to keep the two subjects separate, because the materials used for basketry, matting and rope are different from those used for textiles, as are the basic construction techniques (Wendrich 1991). Leather is separate from textiles, because the basic range of raw materials and the techniques used for making leather items differ from those associated with textiles (Vogelsang-Eastwood 1993:12).

The archaeological periodization used in this publication:

Period	**Date**
Early Bronze Age	3600 - 2000 BC
Middle Bronze Age	2000 - 1550 BC
Late Bronze Age	1550 - 1200 BC
Iron Age I	1200 - 1000 BC
Iron Age IIa	1000 - 925 BC
Iron Age IIb	925 - 725 BC
Iron Age IIc	725 - 539 BC
Persian Period/Iron Age III	539 - 332 BC
Hellenistic Period	332 - 63 BC
Roman Period	63 BC - AD 324
Byzantine Period	AD 324 - 661

1.4 Research history

In the 19th and early 20th centuries, archaeologists were more aware than nowadays of the many different kinds of textile crafts because society was less industrialized and these crafts were visible in daily life. Scholars such as Macalister (1912), Petrie (1917), Guy (1938), Albright (1943) and Tufnell (1953) recorded and interpreted their finds in the light of what they had seen at home in combination with what they saw in everyday life in the Middle East. Their interpretations are often very interesting, and even after so many years it is worth studying their detailed observations.

At the beginning of the 20th century, Mrs Crowfoot was the only (self-taught) specialist in the field of archaeological textile research of the Middle East. Grace Mary Crowfoot (née Hood) (1877-1957) was married to J.W Crowfoot, who worked in Egypt and the Sudan, first as an inspector of education and later as an archaeologist. Mrs Crowfoot was interested in biology and in crafts. She recorded several kinds of crafts, such as pottery making, weaving and spinning. She also learned to weave and experimented with various materials and techniques from the Sudan and Egypt, publishing these experiments. Experiencing the crafts alongside detailed observations of local people working helped her interpret and understand the excavated textiles and the Pharaonic paintings. She developed a unique specialism slowly, combining archaeology with ethnological observations and experiments in many textile crafts. She worked with Petrie on the textiles of his excavations in Egypt, experimented with plant dyes and continued to publish on spinning and weaving (Crowfoot 1931; 1937).

When John Crowfoot was appointed director of the British School in Jerusalem, Mrs Crowfoot became involved in Palestinian archaeology. At the excavations of Samaria/Sebaste, John and Grace Crowfoot met Kathleen Kenyon. Later, Mrs Crowfoot worked on Kenyon’s material from Jericho. Her list of publications on Palestinian textiles was already impressive (Crowfoot 1941; 1943a; 1943b; 1944; 1945a; 1945b; Crowfoot and Kenyon 1957) when she involved herself in the publications on the textiles from Qumran (Crowfoot 1951; 1955). After her death, her daughter Elisabeth completed the final publication (Crowfoot and Crowfoot 1961). Elisabeth continued in her mother’s footsteps and published on textiles from the Middle East (1960). G.M Crowfoot is regarded by many as the founding mother of modern archaeological textile research in the Middle East.

Gustaf Hermann Dalman (1855-1941) was a German theologian, philologist and orientalist. He was the first director of the *Deutsches Evangelisches Institut für Altertumswissenschaft des Heiligen Landes* (German Protestant Institute for the study of the Holy Land in Antiquity) in Jerusalem, from 1902 to 1917. Dalman did extensive fieldwork in Palestine, collecting information on Palestinian folklore and music (Dalman 1901); he recorded daily life in the southern Levant, dealing with all aspects of the economy, crafts, its terminology and customs, which resulted in a seven-volume work titled: *Arbeit und Sitte in Palästina* (1928–1942). Volume five on textiles, spinning, weaving and clothing is still a valuable source on the almost vanished crafts and tools from the southern Levant (Dalman 1937). Dalman had a profound knowledge of Jewish sources, especially the Mishnah and Talmud, and he was a prolific writer in many fields including theology,[4] Palestinian Aramaic,[5] and the historical geography and topography of Palestine.[6] From 1905 until 1926 Dalman was editor of the *Palästinajahrbuch*.

Robert Jacobus Forbes (1900-1973) was a Dutch chemist of Scottish origin and a professor in the history of applied science and technology at the University of Amsterdam. As a science historian, Forbes wrote nine famous volumes titled: *Studies in Ancient Technology* (1955-1964). Volume IV on spindles and looms, fibres and fabrics, dyes and dyeing, spinning, sewing, weaving and basketry in antiquity served for a long time as the major work on the technological aspects of these subjects. Forbes also published on mining and geology, building materials, paint, bitumen, the art of distillation, etc. Some of his studies are unique of their kind and are still being used.

In the 1960s and 1970s, the discussion focused on the function of perforated clay balls found in excavations, especially by archaeologists who were not aware of how weaving was performed, and of how the warp-weighted loom with its loom weights had been used in antiquity.
R.A.S. Macalister (1870-1950) identified different types of perforated clay objects as *weaver's weights* in his report on Gezer in 1912.[7] Thereafter most archaeologists followed this identification, until Benjamin Mazar in 1950/51 suddenly changed his mind in his reports on Tell Qasile. At first he identified these objects as loom weights, but than he came up with an alternative: the perforated clay balls were supposed to have been used as heat retention artefacts. And in 1964 Mazar stated that the perforated (unfired!) loom weights from Ein Gev might have been used as fishing weights (1964:25). In his 1966 publication on Ein Gedi he suggested that the perforated clay balls had been used to store heat. In his publication on Ta'anach in 1969, Paul Lapp suggested that the pendant weights were loom weights, but the sixty large unfired donut-shaped weights, excavated from the Cultic Structure, could not have been used on a loom, according to him. He followed the idea of Mazar, but added another idea: the large and soft donut-shaped weights were used in a religious context. 'Groups of these 'doughnuts' may have been used to absorb heat in connection with the burning of sacrifices. Perhaps the large eight-handled crater in which the Ta'anach hoard was found was also associated with sacrifices.' (Lapp 1969:47).

Of general importance for textile research of the Iron Age is the work of Avigail Sheffer and Orit Shamir. They applied the results of textile research from Europe, especially the work of Marta Hoffmann (1964; reprinted 1974), to material excavated in Israel. In 1976 Avigail Sheffer published a comparative analysis of textile impressions on Negev ware pottery from Tel Masos, which was followed in 1981 by her article 'The Use of Perforated Clay Balls on the Warp-

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[4] *Der leidende und sterbende Messias* (1888); *Jesaja* 53 (1914); *Worte Jesu* (1930);
[5] *Grammatik des jüdisch-palaestinischen Aramäisch* (1905); *Aramäisch-neuhebräisches Wörterbuch* (1922); *Aramäische Dialektproben* (1927);
[6] *Petra* (1901); *Neue Petraforschungen* (1912); *Orte und Wege Jesu* (1924); *Hundert Fliegerbilder aus Palaestina* (1925), *Jerusalem und sein Gelände* (1930), and together with P.P. Levertoff, *Sacred Sites and Ways* (1935).
[7] For the identification and typology of the perforated clay balls, the publication of Macalister is indeed what R. Moorey wrote of it: 'With all their faults, the three volumes of *Excavations at Gezer* (1912) endure as one of the major contributions of the pioneer phase of excavation in Palestine.' (1991: 32).

weighted Loom', in which she clearly confirmed that clay loom weights were being used in the warp-weighted loom.

Together with Amalia Tidhar, Sheffer published the textiles from Kuntillet Ajrud (Sheffer and Tidhar 1991), which was the first Iron Age collection of textiles analyzed and published in the region. For a while these fifty textile items were the only referential collection, apart from some individual items such as the textile fragment from Deir Alla phase IX (Chapter 6 and 11).

In 1991 Elisabeth Barber published an important work on prehistoric textiles: *Prehistoric Textiles; The Development of Cloth in the Neolithic and Bronze Ages.* This book combines detailed information on textile crafts and text analysis. Barber's research was not limited to the Aegean but also gives an overview of the research in Anatolia and the Southern Levant up to 1990. She could not include the archaeological material from the northern Levant in her research because that material was not known until about 2000, when Serena Maria Cecchini started publishing the finds from Syria (Cecchini 2000).

In 1998, Glenda Friend published the loom weights of Tell Ta'anach. This was the first monograph on loom weights from the Southern Levant. To interpret finds in the light of our own (Western) traditions without enough knowledge of the techniques of the production process is a pitfall in archaeological research.

Elisabeth Barber showed how strongly we are attached to our own point of view when we interpret finds from the archaeological record. The restoration and interpretation of the spindle can serve as an example. In Europe and the Middle East the 'low spindle', with the whorl located at the base of a stick, was usual, while in Egypt the whorl was put on top of the stick, resulting in what is called the 'high spindle'. Museum exhibits not always familiar with this difference generally restore their spindles with the whorl at the base. Barber (1991: fig. 2.7) noticed that an Egyptian spindle from the British Museum was exhibited and photographed upside down, which could be deduced from a thread groove at the wrong end of the shaft.

In 2007, when Orit Shamir published the textile finds from Kadesh Barnea (Tell el-Qudeirat), a new collection of Iron Age textile fragments was added to act as a reference. Before publishing this major collection of textiles and textile-related finds from the desert site of Kadesh Barnea, Shamir had published on tools used in textile production from many different sites and periods in Israel: Tel Miqne-Ekron (1991), Beth Shean and Hurvat Nimra (1992), Tell Qasile (1993;1994), Masada (1994), Jerusalem (City of David) (1996), Khirbet Nimra (1997), and Horvat Rogem, Horvat Mesura and Horvat Ha-Roa (2004).

Sometimes textile tools and crafts are misinterpreted because archaeologists have not the slightest idea about the use of these tools, which results in the mystification of textile production. Zwi Gal, while digging at Horvat Beit Zayit, found many loom weights in the public areas in a fortress. In his opinion the nature of the site casts doubt on the use of perforated clay balls as loom weights, and because he found two jars with two loom weights on top of the opening, he suggested they were being used or reused as jar stoppers. He then supposed that the other 250 jars found at the site had also been covered by the remaining sixty excavated loom weights, which were, however, not found in connection with these jars (Gal 1989). Stager (1996) used this idea in his discussion about the Ashkelon winery, after which Weiss and Kislev adopted this idea in their article on plant remains from Ashkelon (2004: 36). Finally in the same year, this confusion about jar stoppers and loom weights caused Michael Homan to invent a special stopper, the 'fermentation stopper' (2004). Homan studied the process of beer production in Egypt and Mesopotamia, and wondering if and how beer could have been produced in the Southern Levant, he found the 1989 article written by Gal. Reading about the jar stoppers and seeing that many jars contained grain, he decided that the perforated clay balls found in so many Iron Age sites, sometimes with fragments of cloth inside the perforation hole, were used in beer production. Homan suggested that the clay balls had originally been covered with cloth, and that the perforation hole in the clay ball served to let the gas evaporate from the beer during the fermentation process. After that excursion the perforated clay balls were again fastened to the warp-weighted loom and they have not been discussed since as being something other than loom weights.

In 2011 Master re-examined the perforated clay balls and jar stoppers of 7th-century Ashkelon, using the criteria drawn up by Sheffer (1981) and Shamir (1996; 2006), and a clear distinction could be made between jar stoppers and loom weights.

1.5 Research on loom weights from Iron Age Transjordan

The work of Barber, Sheffer and Shamir served as inspiration and reference because in 1998 hardly any artefacts used in textile production had been published from Jordan.
The first to publish loom weights from Jordan was Pritchard in his volume on Tell es-Saidiyeh. He published plans and pictures showing the loom weights in situ (1985:15-38; fig. 52, 73, 74, 88, 89). Figure 170:1 shows a group of loom weights and an impression of woven cloth on clay from house 16 in Stratum V. This volume is a unique publication because no finds associated with textile production from Jordan had ever been published in such a detailed manner. Now, after so many years, this publication enables a surprising interpretation that will be discussed in chapter 10.
Khair Yassine in his 1988 publication on the archaeology of Jordan mentioned the many loom weights found at Tell Mazar. He published photographs of the hordes of loom weights in situ and pictures of groups of loom weights together with pictures of other artefacts used in textile production. The loom weights of Tell Mazar were studied by me and discussed in Chapter 7.
In 1989, Gillian Vogelsang-Eastwood published the first textile research on Iron Age material from Jordan. Her research on the hemp textile found in Deir Alla and finds associated with textile production was published as the chapter *Textiles* in the catalogue to an exhibition in the Leiden Museum of Archaeology. The catalogue was entitled *Picking up the threads…* (Vogelsang-Eastwood 1989; Van der Kooij and Ibrahim 1989). The loom weights of Tell Deir Alla phase M and IX are studied by the author and will be discussed in Chapter 6.

1.6 Transjordan in Iron Age II and the Persian Period (Iron Age III)

The finds discussed in this book are mainly from sites dated to Iron Age II and the period of transition to the Babylonian and Persian Period (Iron Age III). The late Iron Age was a time of great political change in different regions of the Southern Levant. The next section provides a brief political history of the region under study.
Iron Age Transjordan was divided into several small kingdoms/chiefdoms, the borders of which can be drawn mainly according to geographical features. To the west, the river Jordan was the natural border with the kingdoms of Israel and Judah, to the east Transjordan was bordered by the Arabian Desert,[8] while in the north the Yarmuk River formed the border with the Aramean states.
Gilead was situated in the northern part of Transjordan, and the Zerqa (Jabbok) River was the natural border between Gilead and the kingdom of Ammon, though this border appeared to be flexible over time (see below). To the south, the Wadi Hesban bordered the kingdom of Ammon. The kingdom of Moab consisted of the Plains of Moab and the Northern Plateau, while south of the Wadi Mujib (Arnon River) was the Kerak Plateau. The geographical border between Moab and Edom was the Wadi al-Hasa (Zered River), but over time this border was not fixed. The kingdom of Edom was situated west and east of the Wadi Arabah, bordered by the Red Sea in the south.

Iron Age II

Inscriptions show that from c. 845-785 BC Damascus acted as the dominant power in the southern Levant (Liverani 2005:114). Transjordan, situated on the fringes of the Aramean kingdom, showed a diverse and dynamic political landscape. The small kingdoms of Ammon, Moab and Edom were independent polities trying to keep this status in their relationship to the outreaching power of Assyria, while Northern Transjordan (Gilead), like parts of Northern Israel, the coastal

[8] The rainfall lessens rapidly as one moves eastwards; approximately fifty to sixty km east of the Jordan the generally rugged and cultivable land gives way to a rocky desert.

plain and central Syria, were influenced by the kingdom of Damascus ruled over by Hazael and his family (Liverani 2005:115 and map fig. 28).
According to Liverani (2005:115) '(…) the Aramaic occupation may have left imposing architectural traces at Dan, Megiddo (IV), Hazor (VI), Jizreel, and in the reoccupation of Deir Alla (Stratum IX) after a century of abandonment'. Deir Alla phase IX did not exhibit any imposing architecture, but the idea that Deir Alla underwent influences from the north (Damascus) is correct, as shown by the material culture of phase IX. The loom weights (Boertien 2004: 312 and Chapter 6), stone implements (Petit 1999:157), pottery (Van der Kooij and Ibrahim 1991:24-26; Wenning and Zenger 1991), and the language of the Balaam inscription all point to relations with Damascus and Hama (Van der Kooij and Ibrahim 1989: 66; Hoftijzer and Van der Kooij 1976; Ibrahim and Van der Kooij 1991; Puech 2008).

Map 1.1. The Levant in the Iron Age, with the sites under study.

The border between Ammon and Gilead was flexible in the late Iron Age IIC and in the Persian period (Iron Age III); the Central Jordan Valley belonged to the kingdom of Ammon, as can be seen in the material culture of Deir Alla (Petit 2009:224; Groot 2010:113) and Tell Mazar (Yassine 1988:87, 140, 143-155; Van der Steen and Yassine in press). Whether Gilead was a

toponym or an Assyrian province[9] is still debated [10] (for an overview of this discussion, see Dijkstra and Vriezen forthcoming 2013). The region of Gilead was probably situated to the north of the kingdom of Ammon in the northern hill country.
The accounts of Shalmaneser III (858-824) indicate that Ammon was an independent kingdom (Annals, Assur Clay tablets COS 2.113 B). In this text Baasa, the son of Ruhubi from Ammon, is listed alongside the kings of Aleppo, Damascus, Hamath, Arvad and Ahab the Israelite, all of them delivering thousands of soldiers to the Assyrians. The kingdom of Ammon is thus listed together with the northern kingdoms, while Moab and Edom are never mentioned in these early accounts.
Later, in the building inscription of Tiglath Pileser III (744-728 BC), Ammon is mentioned together with the neighbouring kingdoms of Moab, Edom, Judah, Ashkelon and Gaza, all of them delivering tribute such as all kinds of metals, 'linen garments with multi-coloured trimmings, the garments of their lands, red purple wool…all kinds of costly articles, produce of the sea and (dry) land; commodities of their lands, royal treasures, horses (and) mules broken to the yo[ke].' (Tadmor and Yamada 2011:121-123).

Ammon
Ammonite material culture was distributed throughout the hill country around its capital Rabat-Ammon, situated on the Amman citadel. Society was small-scale and consisted of townships such as Tell Jawa, Tell Jalul, Sahab and Tell al-Umayri in the south and Tell Safut north of Rabat-Ammon. The border with Gilead in the north was flexible, showing strong Ammonite ceramic influences at Tell Deir Alla and Tell Mazar and in Ammonite inscriptions and seals at Tell Mazar (Yassine 1988: 33-46; 137-155; Daviau and Dion 2007: 302). In the 7th and 6th centuries BC, Ammonite culture flourished and showed signs of change due to the political situation, but the principal sites remained well connected with each other and provided agricultural resources for the local administration (Daviau and Dion 2007:306).

Edom
According to Bienkowski (1995b:135-143), the Edomite state emerged only in the 7th century BC. But in the building inscription of Tiglath Pileser III, dated to 728 BC, the Edomite king Kaushmalaku is listed as a giver of tribute, along with a number of Levantine kings such as King Sanipu of Bit Ammon, Salamanu of Moab, Iauhazi (Jehoahaz) of Judah, Mitinti of Ashkelon and Hanno of Gaza (Tadmor and Yamada 2011:122; COS 2.117D). The factors leading to Edomite statehood were the stability of Assyrian control and the improved economic opportunities. But according to Bienkowski and Van der Steen there is no evidence for the actual presence of Assyrians in Edom, and Tel Haror and Tell Abu Salima can be interpreted as administrative centres, located at the end of the Arabian trade route to guarantee Assyrian involvement (Bienkowski and Van der Steen 2001:39, 40).

Moab
The kingdom of Moab in Iron Age II – known to us from the inscription on the Mesha stela – shows the emergence of a regionalized political landscape comprised of small, autonomous polities anchored by central settlements (Harrison 2009). The Assyrian presence did not leave clear traces in Moab, and in contrast to Ammon and Edom there are no clear archaeological signs that this period was a prosperous one for Moab (Stern 2001:267).
Moab does not figure in the earliest encounters between Assyria and the Levant. It first appears in the building inscription of Tiglath Pileser III, dated to 728 BC, where the Moabite king Salamanu

[9] The province of Galada/Galaza as mentioned in the Assyrian lists is still debated. Recent editions, however, have Galadi/da (Tadmor & Yamada 2011; Dijkstra and Vriezen forthcoming).
[10] The Assyrian records reveal that Tiglath Pileser incorporated the area of Gilead into the Assyrian empire after 732 BC. 'Whether this region was also instituted to be a separate province, is less certain, though plausible in view of the earlier and later history of the area. Presumably, this did not happen under the name Galada, as found by Tiglath-Pileser, but as part of the larger province of Qarnina (Carneas) or the Province of Haurana.' (Dijkstra and Vriezen forthcoming 2013).

is listed as a giver of tribute, along with kings from the Northern Levant and the southern Levantine kings of Ammon, Edom, Judah, Ashkelon and Gaza (Tadmor and Yamada 2011:122; COS 2.117D). Routledge (2004:201-203) convincingly argues that the kings bring a *madattu*, an annual obligation of polities who had submitted themselves to the Assyrian king as clients, and not a *tamartu*, a gift of loyalty. It can be assumed that Tiglath Pileser III did not submit a *madattu* for Moab in the course of his campaign in 734 BC.
During the reign of Sennacherib (704-681 BC) the situation changed, because in Sennacherib's accounts of his third campaign, the kings of Ammon, Moab and Edom are listed as bringing gifts (*igisu*) and heavy *tamartu* presents to him and kissing his feet (COS 2.118i; COS 2.119B; ANET:287). From the period between Sargon II (723-704) and Esarhaddon (680-669 BC), a list of tribute from Palestine is known (COS 1.137; ANET:301), mentioning Ammon and Moab giving gold, and Judah and Edom giving silver.[11] Esarhaddon mentions the kings of Edom, Moab and Ammon among the 22 kings of 'Hatti, the regions at the other side over the river (Euphrates) the seashore and the island' sending him all kinds of materials of wood and stone (Leichty 2011:46). Ashurbanipal (668-633 BC) mentions the kings of Edom, Moab and Ammon, in his record of operations against the Arabs of Syria and Transjordan, among 'the 12 kings from the seashore, the islands and the mainland', servants bringing heavy gifts (*tamartu*) and kissing his feet. He made them 'accompany his army over the land as well over the sea-route to Egypt' (Smith 1871:30-31 and Luckenbill in ANET:294).
The kingdoms of Ammon, Moab and Edom choose to surrender without a fight, accepting Assyrian domination, and did not participate in the rebellions that erupted from time to time in the western part of the empire. They acted as vassal kingdoms and paid an annual tribute to the Neo-Assyrian kings. The Assyrian system of vassaldom prevented fighting between and among neighbouring states (Stern 2001:10, 259, 293). The Assyrian regime, in its turn, supplied the kingdoms of Ammon, Moab and Edom with necessary defence against threatening Arabian tribes coming from the eastern desert, and unified the regional kingdoms under one overlord. The vassal kingdoms and provinces in the Southern Levant did not display a tendency towards cultural unification (Groot 2010:257). The period of Assyrian domination in the kingdoms of Ammon and Edom appears to have been one of continuing economic and cultural prosperity (Stern 2001:237, 259, 268). In Moab there is no clear archaeological evidence for economic prosperity, although Assyrian texts (from 704 BC onwards) mention Moab as a small kingdom/chiefdom with military and economic capability, sending soldiers, gold, wood and stone as gifts of loyalty (*tamartu*) to the Assyrian kings (Stern 2001:267; Routledge 2004:201-203). This might be confirmed by recent finds from Khirbet al-Mudayna that surprisingly yielded imported Assyrian pottery (pers. comm. Daviau). The economic and cultural circumstances of Moab are still opaque, and to remedy this situation more excavations need to be undertaken.

The Babylonian and Persian Period (Iron Age III)

When the Assyrian Empire collapsed and was superseded by the Babylonian Empire, the Babylonians presumably also controlled Transjordan. The first half of the sixth century BC, from the Assyrian collapse in 614-610 BC to the formation of the empire of Cyrus the Great in 550-539 BC, is a period of deep depression for a large part of the Near East. According to Liverani, the crisis is similar to the crisis that marked the change from the Bronze to the Iron Age in the twelfth century BC. The remarkable difference between these two crises is that in the 6th century there was an ideological change but material culture did not visibly change because the material conditions of existence did not change (Liverani 2005:231).
During the reign of the Persian king Cambyses II (530-522 BC), the role of the Southern Levant changed from a border region to an integral part of the empire. Darius's reign (550-486 BC) consolidated the empire, which by now was the largest ever seen in the Near East. He set out to reform the administration and organization of the army and divided his empire into twenty satrapies, which were led by governors/satraps. The Southern Levant was part of the satrapy of Abar Nahara, which included Babylon and the entire Southern Levant (Groot 2010:111).

[11] Byblos is also mentioned but what kind of tribute was required is illegible.

Gilead yielded only a few remains from the Persian period, mainly silos; some pottery has been published from Abila (Wineland 2001:103), Tell Mugayyir (Ibrahim and Mittmann 1986:171) and Tell el-Fukhar (Strange 2002). From these finds no general conclusions on the situation in Gilead can be drawn. In this period the Central and Southern Jordan Valley can be regarded as being part of the vassal kingdom of Ammon, or otherwise connected to the Ammonite social sphere (Groot 2010:113). During the Persian period the Southern Jordan Valley remained densely occupied while the Central Jordan Valley was sparsely inhabited. The occupation of Deir Alla and Mazar seem to have been rural, while at Saidiyeh the excavator has suggested more substantial government presence. Here a small fortress has been excavated, a substantial courtyard building with heavy walls that remained in use until well into the Hellenistic period (Fischer 1994;1996). At Tell Mazar the buildings of Stratum II (Persian period) are private houses, the finds revealed official stamps and stamp impressions (Yassine 1988:143-155), metal objects, bronze and silver jewellery (Yassine 1988:79-82) and four large groups of loom weights (Chapter 7). An ostracon (JUM 222/79) with nine lines of text comprises list of personal names. The script is dated to the 5th century BC and is regarded as Ammonite. Some of the names are conspicuous such as *mlqmyt* in which the name of Milcom can be read, HSL'L according to Yassine is the name of the Ammonite king Hazael (*c.*620 BC), and the name *yqm*[']*l* is also known from the Arad ostraca (Yassine 1988:140-141; fig. 8 and 9). These finds indicate development and prosperity. The site was abandoned in the middle of the 4th century BC.

According to Groot, in Ammon during the Persian Period the character of the region changed from a small-scale urban society to a predominantly rural society (2010:112). The focus on rural life is illustrated by the abandonment of the towns of Tell Safut and Tell Jawa before or early into this period. Rich tomb assemblages have been found at Abu Nuseir, Khilda and Umm Udhayna in the countryside, and, like Tell Mazar, they testify to a certain level of prosperity during the Persian period (Yassine 1988:11-31; Groot 2010:112). An exception is Tell el-Umayri, where a late seventh century/early sixth century administrative complex has been excavated, this complex fell into decline during the Persian Period (Herr 2002:18-19).

The situation in Moab during the Persian Period is difficult to estimate as little evidence for this period has been recovered from excavations. Edom's capital Buseirah and Umm el-Biyara yielded architectural remains dated to the Persian Period, whilst in Tawilan a cuneiform tablet dated to the Persian period was found (Stern 2001:274), indicating that the Persian period left traces in southern Transjordan. Persian rule ended in 333 BC when Alexander the Great defeated the Persian king Darius III Kodomanus at the battle of Issus, after which the southern Levant became part of the Hellenistic empire of Alexander the Great. The whole region became a blend of Hellenism and Semitic Aramaic culture in varying proportions (Mansfield 2004:7).

1.7 Levantine textile production and the Assyrians

It has been suggested that the rise of textile production in the Southern Levant was related to demands from the Assyrians (Browning 1988:154-158; Kelm and Mazar 1995:163). Indeed, textiles are mentioned in Assyrian tribute lists of Tiglath Pileser III (744-727 BC), in which the states and tribes[12] of Transjordan are explicitly mentioned (Tadmor and Yamada 2011:122; COS 2.117D; Eph'al 1984:223-227; Weippert 1987a:99).

This study will show that the increasing numbers of loom weights were not the result of Assyrian demands for textiles, because the numbers had already increased long before the Assyrian domination of the 7th century BC. It is therefore more probable that the increasing numbers of loom weights found in excavations resulted from a change in weaving techniques. This change in technique, which resulted in the use of loom weights, was introduced to the region in the Early

[12] For a discussion on tribes and states in Transjordan see Bienkowski and Van der Steen 2001.

and Middle Bronze Ages (see Chapter 3.3). During the 9th-8th centuries BC, the warp-weighted loom enabled the production of special kinds of textiles, requiring three or more rows of loom weights in a set, raising the number of loom weights on a loom. It was only in the 7th century BC, after the production of patterned and coloured textiles had developed into a famous Levantine tradition, that the Assyrians desired these special local textiles as a tribute.

Garments were collected as an annual tribute together with whatever was considered precious for the royal treasury of Assyria, and no mention is made of production of such textiles at the demand of the Assyrians. The texts confirm this situation by referring to the production of these textiles as a local tradition, as can be read in the tribute lists of Tiglath Pileser III (744-728 BC) and Esarhaddon (680-669 BC), where the textiles are mentioned as '... the garments of their lands', in the translation by Tadmor and Yamada (2011:58,122) '… garments of their native industries', in the translation by Luckenbill (ANET:282, 283, 291). Apparently these garments were recognizable as being 'garments of their lands', as they were made in a local style and thus were a product of the native textile industry.

Fig. 1.1. King Ashurbanipal (668-627 BC) and his wife, wearing garments with multicoloured trimmings (after Houston and Hornblower 1920).

After Ammon's subjection to Tiglath Pileser III in 732 BC it became a vassal of Assyria and had to pay tribute; in return Assyria allowed a measure of autonomy. Sanipu of Bit-Ammon is mentioned in the list of Tiglath Pileser III (744-727 BC) of all the kings of the region who paid tribute: 'gold, silver, tin, iron, lead, multi-colored garments, linen garments, the garments of their lands, red purple wool, all kinds of costly articles produce of the sea and (dry) land; commodities of their lands, treasures, horses and mules broken to the yo[ke]' (Tadmor and Yamada 2011:122-123;). 'Blue-purple and red-purple garments, multi-coloured garments.' (COS 2.117B).
The translation by Luckenbill (ANET:282) mentions textiles in a slightly different way '…linen garments with multi-coloured trimmings, garments of their native (industries) being made of dark purple wool….'
Tadmor and Yamada (2011) do not use the term 'multi-coloured trimmings' in their translation of the campaigns of Tiglath Pileser III, but Leichty (2011:75), in his translation of the royal inscriptions of Esarhaddon (681-669 BC), uses this technical term in regard to the tribute of the king of Sidon.
It seems reasonable to use the technical term 'multi-coloured trimmings' for the multi-coloured woven woollen bands decorating the linen garments of the Assyrians, as can be seen on the reliefs from the palace of Ashurnasirpal II (883-859 BC), discussed by Thomason (2010:198-210) and on

the reliefs from the period of Ashurbanipal (668-627 BC), drawn by Houston and Hornblower 1920 (fig. 1.1).
It can be concluded that the Assyrians appreciated local textiles from the Southern Levant and desired the woven textiles as well as the red or dark purple wool that was produced by Levantine local industries. More about the textiles used by the Assyrian kings can be found in Chapter 10, while details about the colours and dyes used in the Iron Ages are discussed in Chapter 2.5.

Chapter 2 Textiles

This chapter provides background information on the different aspects of archaeological textiles. It provides information on the texture and appearance of textile, textile manufacture and its potential use. A discussion on the production processes of fabrics, starting from the raw materials and leading to the production of yarn and cloth, forms the main part of this chapter. Some dyeing techniques and a list of dyestuffs used in the Levant will follow.

2.1 From fibre to fabric

First some definitions will be given to clarify the basic terms textile, cloth and fibre:

Textile

The word textile is taken from the Latin word *texere,* meaning to weave. The word refers exclusively to woven cloth, excluding felt and felt-like cloths, which are constructed from fibres that have been made to cohere by some means other than weaving (Barber 1991:5). Textile is differentiated from matting and basketry by the choice of materials. Mats and baskets are made of stiff materials and can be made without using a loom whilst cloth, as a soft material, needs the support of a loom.

Cloth

Cloth or *fabric* is the general word used for every flat material made of fibres.
Cloth was defined by Barber as being 'large thin sheets of material made of fibre, which are soft and floppy enough to be used as coverings for people and things' (Barber 1991:5). Descriptive terminologies in textile studies have been published by Desrosiers (2010:27-28). See also 2.3.

Because very few objects made of cloth have survived, we must speculate on its various uses. From texts, pictures and the use of common sense it can be assumed that textiles served various uses:

- Personal use: clothing, sheets and towels
- Soft furnishings: bedding, curtains, cushions and pillows
- Household use: wall hangings, floor coverings, lamp wicks, bags, jar and pot covers, covers for stoppers
- Exterior use: animal traps, sails, grain covers (Vogelsang-Eastwood 1993:80)
- Funerary use: shrouds and grave clothes
- Cultic use: covers of religious objects, liturgical clothing, flags and pennants.

Fibre

Fibre is a long and narrow hair-like component of plant or animal tissue, and by extension, the smallest linear component (natural or manufactured) used to create a yarn or textile. Usable textile fibres can be extracted from the stems or leaves of many plants, some wild and others domesticated. Examples of the latter include linen, which comes from the stems of the flax plant, and cotton, which is a seed hair. Likewise, the hair of many animals, such as sheep, as well as the silk of the silkworm, can be used to make textiles. In the Levant, different textile fibres are known from written sources and also from organic remains (see below). Common animal fibres used to produce textiles were sheep's wool, and goat's hair. Both are well known from the written sources of different periods in this region.
Two plant fibres were in use in the Levant as material to produce a fine textile: linen, the more famous of the two, and hemp, only recently analyzed as a plant fibre used in the production of textile (Boertien 2004: 306-308). Silk and cotton are relative newcomers to the Levant, both having arrived in the early Hellenistic period (Barber 1991:30-33).

Textiles in the archaeological record
In general, the survival of organic material is determined by geological and climatic conditions. Cloth, as an organic substance, can rot and vanish. It is very seldom that cloth survives, but where organic objects of any type are found, the likelihood that textiles will also be present is high (Vogelsang-Eastwood 1993:12). Textiles survive the ages only under unusual conditions such as desiccation, freezing or anaerobic waterlogging.

Direct evidence for textiles
The basic conditions under which cloth survives (differential survival) can be divided into two main groups. Fibres made from animal proteins such as hair or wool generally survive better under acidic conditions, whilst vegetal fibres (cellulose) tend to be preserved under alkaline conditions.[13] It is essential that the average pH, or scale of acidity, within a site is known, as this helps to identify any excavated textile remains.

Indirect evidence for textiles
Textile evidence can also survive by means of the impressions left in soft substances. The range of materials that preserve cloth impressions is limited. They must be soft and capable of retaining the shape of an object. Textile impressions are always a negative of the original cloth, commonly occurring on materials such as clay and more occasionally on wax, bitumen or lead. The earliest known textile impressions on clay are from 7000 BC Jarmo in northern Iraq (Adovasio 1983:fig. 169.9-10) (See also Chapter 8).
Mineral replacement of textile fibres gives a positive replica of the cloth, whilst the fibres themselves may or may not be preserved. Textiles in close contact with copper alloys such as bronze may be preserved. Iron corrosion (rust) can cover fibres, leaving a small gap between the iron and the textile fibres. These interstices can become filled with soil and form a solid matrix. Inside this mould, a negative cast of the fibres is formed. Lead salts also have a preservative quality, and traces of cloth can at times be found on silver.
Carbonization is another possibility for textile survival, but with direct contact between flames and textile little trace will be left behind. Wool turns into a black mass of bubbles when burned, whilst vegetable fibres will form a white or grey ash. Recognition of textiles becomes very difficult with such traces; however, with indirect contact to fire it is possible for textiles to survive, especially when they are made of vegetable fibre. Such a situation may occur when a burning loom falls on top of a piece of cloth. If the beams of the loom are not totally burnt, the cloth may be preserved underneath. In some cases there will be little or no damage, while in others the textile will have been carbonized to some extent (Van der Kooij and Ibrahim 1989:58,61; Vogelsang-Eastwood 1993:23; Boertien 2004:307) (See also Chapter 6).
A piece of cloth used to cover cups or pots may be preserved in a house fire, as a fallen vessel may protect fibres from direct contact with flames. The cloth preserved beneath vessels in such cases may shed some light on ancient household uses of textiles (see also Chapter 8).

Materials: Animal hair and wool
Animal fibres are defined as the hair of animals that can be used without harming or killing the animal. Early methods of obtaining wool came from pulling it out during the moult; in the Iron Age, wool and hair were obtained by shearing or cutting. In the Levant, wool and related animal fibres from sheep, goats and camels were used.
Based on the structure of the hair, animal fibres are categorized as *kemp*, *hair* or *wool*. Barber (1991:21) classified these categories as follows:

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[13] Since bases more easily hydrolyze peptide bonds than acids, wool and silk are affected by bases and not by acids. This is why wool and silk threads break up into fragments and ultimately dissolve in alkaline. In other words, alkaline decreases the tensile strength of animal fibres (wool & silk). Vegetable fibres (cotton & linen), on the other hand, consist of long polysaccharide chains in which the various glucose units are joined by ether linkage. Since ethers are hydrolyzed by acids and not by bases, vegetable fibres are affected by acids but not by bases.

Kemp is the thickest fibre found on sheep, ranging in diameter from 100-250 microns. Due to its stiffness and short length, about 4-7 cm, kemp is unspinable, and characterized as stiff, bristly, and brittle.
Hair is a thinner fibre ranging from 50-100 microns in diameter. Hairs are spinable, but remain bristly and harsh because their short ends stick out from the thread. Hair and kemp fibres both have a central channel that makes the structure stiff and brittle.
Wool is thinner still, ranging from about 6 to 60 microns in diameter. Having no central channel, this material is supple and fine. The length and thickness of wool fibres from a sheep's fleece vary according to breed, season and climate.
Animal fibres differ markedly from *plant fibres* in that they have scaly rather than smooth surfaces. Wool fibres from domestic sheep also differ from bast fibres due to random kinks in their shape. The natural stretchiness of wool fibres accounts for the elasticity of woollen yarn, and the natural kinkiness of wool accounts for the insulating properties of wool as opposed to linen and other vegetable fibres.

Sheep's wool
Sheep are unique in their degree of woolliness, which is attained through breeding.[14] Sheep (Ovis) have a puzzling history because their genetic difference from wild goats (*Capra*) is opaque. Wild sheep such as *Ovis Orientalis*, the Persian wild sheep, are thought to be the chief progenitor of domestic sheep (Barber 1991:21-24). Recently, sheep and goat bones from the EB I-EB III [3650-2300 BC levels of al-Qarn (Jordan) could be distinguished (Savage and Metzger 2002:121). The sheep are *Ovis aries L*. and the goats *Capra hircus*.[15] The coats of wild sheep and goats consist of fairly short thick bristly hairs known as kemp*,* with a shorter undercoat of fine wool fibres (Davis 2001:156; Reed 1960:137; Bökönyi1974: 159, cited by Barber 1991:22). Fleece of purpose-bred wool-sheep has little or no kemp. This reduction in the hair diameter of the outer coat and the frequent elimination of kemp must have resulted from a long period of human-guided selective breeding. The major changes from the coat of wild sheep are: 1.Development of fleece. 2. Loss of the natural black and brown colour of their wild ancestors. 3. Disappearance of the annual spring moult. Ryder (1969;1983;2005:122) suggests that a fleece did not develop until the Bronze Age. The breeding of sheep with continuous wool growth may have begun in the Iron Age (Davis 2001:161-162). This change prevented the loss of wool and allowed sheep to be shorn when fleece was required (Ryder 1969).[16] In the same period white sheep began to become more common.

Sheep's wool can be removed in various ways. The moult can be plucked or combed, or the animal can be sheared. Moulting sheep were plucked or combed and later, when the annual spring moult had been bred out, sheep were shorn. The fleece was cut from the sheep using special shears, which consisted of two blades hinged together with a single spring; the blades were usually 15 cm in length (Vogelsang-Eastwood 1993:33). Sometimes sheep were washed before shearing to remove dirt and grease from the fleece. One advantage of shearing is that the fleece can be removed in one piece and then rolled into a compact bale for transportation. After transportation, the fleece was prepared by sorting fibres into various qualities. The wool was then washed, scoured, in order to remove dirt, grease (lanolin oil) and squint (dried sheep sweat). The process of scouring remained the same for centuries. The wool was immersed in tubs containing three parts hot water to one part urine. This was then left to stand overnight, whereby most of the squint and lanolin were dissolved. Great care was taken not to stir or agitate the fleece, as this would cause felting. The process produced clean but offensive smelling wool. When the fleece was removed from the tubs, it could be placed over bushes to dry, or placed in a lightweight bag and swung around in circles to remove some of the excess moisture, and then spread out to dry.

[14] An interesting overview of sheep breeding history can be found in Barber (1991:22-30).
[15] Mary Metzger analyzed the bones from al-Qarn. Age-at-death was determined for the bones using Silver (1969). Sheep bones were distinguished from goat bones using criteria established by Boessneck, Muller and Teichert (1964) and Boessneck (1969).
[16] A summary of fleece changes can be found in Ryder (2005:123-24).

Picking or teasing the fleece prepared it for carding, combing or spinning. This involved picking out tangles in the wool along with any foreign matter left after washing and drying. After washing and picking, the clean and dry fleeces were sorted according to hair length and quality. Prior to spinning, the wool was normally carded or combed, removing knots, tangles and any remaining impurities (see below).

Goat hair

Wild goats (*Capra*) and wild sheep have similar hairy coats with woolly undercoats. The degree of woolliness depends upon species and/or subspecies as well as the season (Reed 1960:137). Most varieties of goat produce usable if rather coarse wool and hair, whilst cashmere goats yield very fine fibres (Barber 1991:22). Only the mohair grown by Angora goats resembles the fleece of a sheep. Cashmere is under-wool combed from moulting Cashmere goats, whose coats have changed little from that of their wild ancestors. Amongst goats, unlike sheep, there has been relatively little development of their coats for textile use. Ordinary goat hair has been woven into coarse cloth, used for instance for the tents of the Bedouin.

Goat hair and sheep's wool in antiquity

Finds from Predynastic Egypt show wool and fleece at several sites, such as el-Omari in Lower Egypt (Barber 1991:25)[17]. The earliest textile remains made from sheep's wool are recorded from the north Caucasus and dated to 3700-3200 BC (Shishlina, Orfinskaya and Golikov 2003).[18] Cuneiform tablets of the archaic period from Uruk (3400-3100 BC) list six of the 29 recorded flocks of sheep specifically as wool sheep (*udu-sìg*).

A millennium later, Neo-Sumerian records mention four different types of sheep from which wool was regularly obtained:

1. *Udu-gukkal,* a woolly fat-tailed sheep that gave 2/3 kilo of high quality fleece.
2. *Udu-gukkal-igi-nim-ma*, the highland fat-tail sheep which gave the best quality fleece.
3. *Udu-kur-ra,* the mountain sheep with a much poorer grade of fleece.
4. *Udu-uli-gi,* the most frequent type of sheep that gave over a kilo of very coarse wool (Waetzodt 1972:4-6,17-20,45-48, cited by Barber 1991:25). Dalman (1937:4) says that sheep's fleeces from Ramallah in Palestine weighed 0.96 kg each.

In the Bronze and Iron Ages, sheep and goats were bred and herded (Borowski 2003:30). Redding (1981), Rosen (1986), Zeder (1985,1988) and Sasson (2005) have developed theories and models for animal production goals, animal distribution and herd management in Near Eastern pastoralism. Sheep and goat management models have been discussed and applied to Transjordan by Popkin (2009:146-164). The finds from Kuntillet Ajrud are evidence for the use of wool during the Iron Age in the Levant (Sheffer and Tidhar 1991:13).

In Mesopotamia, goat hair was clipped and sheep's wool was plucked or clipped (Barber 1991: 29). Forbes states that plucking was a Bronze Age activity while shearing only appeared in the Iron Age, around 1000 BC, after suitable metal tools could be manufactured from iron, a more elastic metal than bronze. Shears are first mentioned in a Neo-Babylonian text (Strassmaier 1889:667, cited by Forbes 1956:8, note 35), and classical authors have placed the invention of shears in the Levant (Forbes 1956: 8-9). Shearing is mentioned in the Hebrew Bible (Gen.31:19 and 38:12), where it is called *gazaz*, and sheepshearers *gozezim.* In Old Babylonian texts, *gazazum* is used only in relation to goats, whereas *baqamum* (to pluck) is the verb preferred for the process of obtaining wool from sheep. In Neo-Babylonian texts, however, *gazazum* appears with the word for shears. It seems likely that *gazazum* initially meant *to cut hair*, i.e. the wool of goats, with a knife, but later, with the invention of shears, it was used with the meaning of to shear (Wisti Lassen 2010: 276).

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[17] Davis (2001: 161-162) states that woollen fibre has so far only been traced in the archaeological record in Europe.

[18] Early finds were recorded from Çatal Hüyük in Turkey (Burnham 1965:170) but were later proven to be flax (Ryder 1965; Vogelsang-Eastwood 1987). In Shar-I Sokhta in Eastern Iran, early woollen textile has been excavated and dated to the middle of the 3rd millennium BC (Good 1999).

Camel hair
Camels are even-toed ungulates of the genus *Camelus*. There are two main families:
The Bactrian camel has two humps, short limbs, and is native to Central Asia, Bactria, Sogdia and the Gobi desert, all of which have a land climate. The two humps insulate the back of the animal from heat loss during the cold Central-Asian winters. Its long hair has a consistent quality. Bactrian camels have two coats: a warm inner coat of down and a rough outer coat that is long and hairy. They shed in clumps consisting of both coats, which can then be gathered and separated. The fibre's structure is similar to that of wool. The down is usually 2 to 8 cm long and can be spun into yarn. In addition to the wool, there is long hair that can also be sheared and this is used for making rope.

The Dromedary (*Camelus dromedarius*) or Arabian camel has a single hump, long limbs, and short hair. Native to western Asia and east Africa, this animal originally came from the hot deserts and the steppes of Arabia. Today it can also be found in North Africa. Its short hair protects the animal from heat. Dromedary wool has valuable technological properties, such as low heat conductivity, softness and strength. The fibre diameter is 12-27 microns and the length ranges from 4-12 cm. The production of wool and hair from adult animals ranges between 1 kg (El-Amin 1979), 2-3 kg (Dalman 1937:5) to 5 kg (Keikin 1976). Wool is shed at the end of winter and, if it is not gathered, the animal rubs itself against trees and bushes until the wool is discarded. This *wool* is used for making padded cloth, quilts, and mattresses. Hair from the dromedary is used for making clothes, tents, carpets (Cloudley-Thompson 1965), robes, saddle-girths and blankets (El-Amin 1979).[19]

Camel wool in antiquity
Textual references to the camel and actual finds of this animal are rare in the Middle East before the end of the second millennium BC. Albright stated that the camel was not used in the Middle East before 1100 BC (Albright 1942:96; 1961:206-207). Discussion on the use of camels has continued and the outcome is surprising; despite new research the outcome is that the use of the domestic camel as a pack and riding animal is dated to around 1100 BC. According to Bulliet (1990:36) 'There are no sound grounds for doubting Albright's contention that camel domestication first became a factor of importance in the Syrian and North Arabian Desert around the eleventh century BC.' But this date is not the beginning of camel domestication, because the dromedary was already domesticated for meat and milk in southern Arabia between 1950-1100 BC.[20] Towards the end of the second millennium BC, camels came to be widely exploited and bred in parts of the Middle East. The camel was used as a source of milk and wool, as a pack and riding animal and later, certain societies became, and are still, totally dependent upon them for food, wool, milk, as draught animals, and on their dung for use as fuel (Anthony 1998; Clutton-Brock 1999:158; Popkin 2009:101).
Camel hair is suitable for spinning but there is little archaeological evidence for the use of camelid fibres in the Iron Age in the Levant (Davis 2001:156). Dalman (1937:5) points to the use of camel hair as temper in the clay used to make the *tannur* and also the *tabun* (bread ovens). Camel wool is mentioned in the New Testament where John the Baptist is described as having a garment of camel's hair (Matthew 3:4, Mark 1:6).

[19] Recent information about the camel and the use of camel hair:
http://www.fao.org/DOCREP/003/X6528E/X6528E06.htm <5-8-2011>
[20] Bulliet (1990) links the expansion of the camel to the increase in the incense trade. According to Davis camels were probably domesticated in Southern Arabia between 1030 and 980 BC (Davis 2001: 166). Clutton Brock (1999) states that the camel was domesticated earlier as a pack animal in Central or Southern Arabia (about 1400 BC); it then spread through the Middle East and was, in around 650 BC, also used in warfare (Clutton Brock 1999: 158). Jasmin (2006:145) allocates domestication of the camel to the 13th century BC in Southern Arabia, and Ripinsky (1985:134-141) traces the origin of the camel in Egypt and the Sahara during the Early Bronze Ages.

Horsehair

Horsehair can be used for different purposes, such as rope, string, saddle girths and bags. The horse (*Equus caballus*) is a large odd-toed ungulate mammal, one of ten modern species of the genus Equus. The wild horse (*Equus ferus*) is a member of the horse genus, and was found in Europe and Asia. There are several competing theories about the domestication of the horse. A species is not truly domesticated until it will breed reliably in captivity. M.A. Levine (1990) points out that traditional peoples worldwide routinely tame individuals from wild species by hand-rearing infants whose parents have been killed. Horses were repeatedly made into pets over time, preceding the great discovery that such pets could be ridden or otherwise put to work. Several equine teeth found on archaeological sites show tooth wear that could result only from the friction of a bit against the molars, indicating captive animals - though not necessarily domesticated ones. Settlements in the Ukraine from 4500-3500 BC and sites dated 3500-3000 BC in the northern steppes of Kazakhstan are significant in this respect.

The date of domestication and use of the horse as a means of transport is circa 2000 BC, the date of the Sintashta chariot burials in the southern Urals. Shortly thereafter, however, the expansion of the domestic horse exploded. In the space of possibly 500 years, there is evidence of horse-drawn chariots in Greece, Egypt and Mesopotamia (Anthony 1998; Levine 1990).

According to Popkin (2009:103) and Borowski (2002:291), equids were valuable animals in the Levantine Iron Age. Horses were primarily limited to military purposes, but donkeys were also valuable as the principal use of transportation (Popkin 2009:103). Dalman (1937:6) mentions the use of horsehair in Palestine. Horsehair was used to make the very fine matting inside flour sieves. There is no archaeological or textual evidence available for the use of horsehair textiles in the Levant during the Iron Age.

Human hair

Human hair has been used in different parts of the world during various periods. In the Levant, the use of human hair as fibre material is known in a few objects from the 7th millennium BC Nahal Hemar cave in the Judean desert (Barber 1991:30). However, there is no information on the use of human hair in the Levant during the Iron Age. Reference to magic use of hair can be found in the Hebrew Bible where Delilah wove seven locks of Samson's hair into the weft (Jud.16:16), and later he told her that he did not cut his hair because of a Nazirite[21] vow to God; when Samson's hair was cut he lost his physical power (Jud 16:17-20).

Carding, combing and felting

Prior to spinning, wool is normally carded or combed in order to remove knots and impurities. The catchiness of wool allows it to be spun in two quite different ways: the fibres can be carded so as to lie fluffy in all directions, or the fibres can be combed in parallel as is done with the fibres in bast threads (Barber 1991:20).

Carding (derived from *Carduus*, the Latin word for thistle) is the brushing of raw or washed fibres to prepare them for use in textiles. Carders are two small square or rectangular boards with handles, set with small metal hooks. A large variety of fibres can be carded: wool, cotton and bast fibres being probably the most common. Carding of wool can either be done 'in the grease' or not, depending on a spinner's tradition. 'In the grease' means that the lanolin that naturally comes with the wool has not been washed out, leaving the wool with a slightly greasy feel. A handful of wool is placed on one carder set of hooks, whilst the other card is drawn repeatedly across it in one direction, thus drawing the wool out. When spun the fibres lie in a horizontal direction and a soft and fluffy yarn can be produced, called *wool*. Not all fibres are carded; flax and hemp for example, are threshed. Carders have not been found in an Iron Age context.

Combing the rough materials is a similar type of process. It separates the longer from the shorter fibres, the longer fibres being combed or drawn away from the shorter ones. The wool fibres are

[21] Nazirite vow see Num.6:1-21 and Mishnah Nazir Boertien 1971.

combed parallel to each other. When spun, fibres prepared in this way produce a fine hard thread, called ‘worsted’. A comb is made of a wooden, ivory or metal base with rows of pointed teeth.
Combs are usually used in pairs: one comb for holding the wool, the other for combing it. Two-ended combs made from different materials are known from the Roman period, but it is likely that wool-combs were used in earlier periods as well.
Felting is the process of matting wool or hair together into a stable fabric by a combination of pressure, warmth, and dampness. Heat and moisture cause the tiny scales on the surface of the hairs to stick out, and kneading makes them catch upon each other until they are interlocked (Levine 1977).
Fibre felt is made directly from loose fibres, whereas *woven felts* are spun and woven first with the resulting cloth later subjected to a felting process (Barber 1991:216). These techniques result in a solid fabric. In the Middle East, felting may have been a minor art compared to weaving, but no examples are known from this region. It must be taken into consideration that unwoven felt has an amorphous structure, and therefore does not leave clearly identifiable traces in the archaeological record. Woven felts can hardly be distinguished from regular woven textiles because the typical felt structure disappears in the archaeological record. However, this textile may very well have been used in antiquity due to its practicality and ease of manufacture. Steinkeller (1980) identified Sumerian words from Ur III texts for felt made of goat’s hair and sheep’s wool. These references continue into the Old Babylonian period (Barber 1991:220). Large quantities of felt have been found in Gordion in Anatolia, 700 BC, as discussed in Desrosiers 2010:34, and note 42.
Dalman (1937:8) describes the process of felting observed in Palestine during the 1920s. Dirtier pieces of wool together with old wool and goat hair were used to make felt. Felt was used to produce carpets and coats, and was used as saddle filling. Felt was also used to make caps, the most famous being the well-known red *Fez*.

Plant fibres
There are several plants that can be used as raw material for the production of textiles, such as cotton, hemp and flax. Cotton is fluffy and grows around the seeds of the cottonflower, it takes dye readily but it was unknown in the Levantine Iron Age. Bast fibre such as linen and hemp are taken from the bast of the plants, hence bast fibres. It is complicated to process plant fibres to produce textiles, and it is also complicated to dye textile made of bast fibres, because the structure of plant fibre does not take dye well (see Chapter 2.5). The reason it was still often used lies in the special qualities these textiles offer. Hemp fibres as well as flax and cotton absorb moisture readily. This absorbency contributes to the comfort of the person wearing bast fabrics and it makes the fabrics accept dyes readily. Bast fibres can be bleached white but are often used in their natural off-white colour.

Fibre	*Hemp*	*Cotton*	*Flax*
Cellulose (%)	*67*	*83*	*64*
Hemicellulose (%)	*16*	*6*	*17*
Lignin (%) = light sensitiveness	*3*	*-*	*2*
Fibre fineness (denier)[b]	*3-20*	*1-3*	*2-16*
Moisture absorption (%)	*8*	*8*	*7*
Strength (g/dtex)[c]	*5-6*	*3-6*	*5-6*
Extension at break (%)	*2-3*	*3-7*	*~3*

Table 2.1. Comparison of fibre properties of hemp, flax and cotton. Source: http://www.fao.org/docrep/007/ad416e/ad416e06.htm < 5-8-2011>
[b]*Denier = mass (g) of 9000 m of fibre grams force/unit linear density; dtex = mass (g) of 10,000 m of fibre*

Linen

Linen is derived from the bast fibres of the flax plant (*Linum usitatissimum L.).*

The wild form of flax is *Linum angustifolium,* which has a smaller seed and a more open capsule than the domesticated variety. It grows all around the Mediterranean, from the Canaries to the Black Sea and from the Caucasus to Palestine, but no wild form has been found in Egypt (Forbes 1956:27).

The plants

Flax is an annual of the family Linaceae. There are over two hundred varieties of flax that, depending on the regional conditions and climate, range in length (from 25 to 125 cm), shape (sparsely and heavily branched varieties) and maturity periods (from fast-growing varieties in the northern latitudes and mountainous regions to slower-growing varieties cultivated on irrigated soils in Asia.) Flax blooms in clusters of bluish, navy blue and, more seldom, violet, rosy and white flowers that open at dawn and close and fall at around noon when the heat sets in. Each flower blooms for a few hours only. Bees collect close to fifteen kg of honey from one hectare of flax field. The plant was usually grown for its seeds (a source of oil) and for the fibres, derived from the bast of the herbaceous plant (http://www.linenline.com.au/info/about_linen/ <5-8-2013>).

Fibre flax is generically referred to as long-stalked flax and seed flax as crown flax. Long-stalked flax is cultivated as a spring crop on primarily silt or clay loams in a moist and warm climate. The plant takes about a hundred days to grow from seed to mature plant with a height of between 60 cm and a meter. The longer flax fibres are the more desirable, so flax is usually harvested not by cutting but by pulling up the entire plant, in a bundle of flax fibres (called a *strick*). The flax plants were thus gathered in whole, when they were in bloom, as better fibre could be produced from young plants. Some of the plants were left standing to ripen, and their seeds were collected for next years sowing and for the preparation of linseed oil used in medicines. The coarser fibres of these fully matured plants were used for making strings and ropes (Forbes 1956:28). Flax was sown in ancient Egypt by the middle of November, and pulled out within 110 days, between mid and late March (Allgrove-McDowell 2003:32; Forbes 1956:29). Line 3 of the Gezer calendar mentions the sowing of flax. Which period of the year is meant in this line is a point of discussion. In Mishnaic times flax was sown in Adar, a month that falls within the period mentioned in the line in question. (See also Chapter 10.4). Today flax is sown in December and harvested in July (Borowski 2002:35).

From flax to linen

The stem of flax was used for basketry because of its great strength and suppleness. The plant and its fibre are called flax; the spun thread and the fabric woven from it are referred to as linen.

Flax was pulled out by hand, because it was important to keep the stalks straight. The plants were uprooted, turned upside-down and the earth adhering to the roots shaken off. Sheaves were formed with the blue flowers showing at both ends of the sheaf. After drying the flax was rippled with a big-toothed comb to remove the seed capsules. Then the flax straw was subjected to a biological treatment (retting, or controlled rotting) to break down the binding between the fibrous and woody portions of the plant. For this purpose flax was unbundled and spread on the ground (dew retting) or wetted in special basins. Forbes (1956:30) notes that sometimes flax seems to have been boiled in a pot. The flax remained in the water for ten to fourteen days. During this time a bacterial fermentation decomposed the pectin that cements together the bast fibre and the woody portion. Flax fibres gain in strength when wet due to the high pectin content, which acts like glue under moist conditions. It took from two to three weeks to complete the process of separating the fibres from the wood. The resultant straw, called *stock,* was dried and then treated to separate the long and the short fibres. This process consisted of three stages. Firstly, the straw stems were spread into a continuous uniform layer and turned at a certain angle to achieve their parallel alignment. Secondly, they underwent a crushing process, whereby the straw stems were first crushed and broken so as to separate the woody central portion of the flax stem. The wood breaks up while the fibre bends and remain intact. The resultant straw is called crude fibre; the stem-wood so separated is called ‘shives’. The final and most important operation in obtaining the long fibre was carried out by skutching the crude fibre. Skutching is beating out the wooden parts to separate the long fibre from the woody portion. Prior to spinning the long fibre was combed with the help of a hackling comb to produce fine and slightly curled plaits, called ‘rove’. Care was taken to split the fibres without breaking them. After the rove was bleached (and dyed) it was ready for spinning to produce the famous linen yarn.

Linen in the Levant and Egypt

Flax textiles have been found from the sixth millennium BC onwards in the Near East. Seeds and seed impressions of flax have been found at Neolithic sites in Europe and the Near East (Renfrew 1973:120,122). In Europe flax was probably the main source of bast fibre. Preserved textile fragments from fourth and early third millennium BC Swiss lakeside villages are all linen.

In Egypt the production of linen has a long history. Linen textiles from the Fayum region are dated to c. 5000 BC (Vogelsang-Eastwood 2000:270). Examples of linen textile have also been found from the Predynastic period (Forbes 1956:27; Vogelsang-Eastwood 2000:269-270). Flax is not a native of Egypt; it is possible that it was imported from the Levant (Germer 1985:101 cited by Vogelsang-Eastwood 2000:269). There is textual evidence for the production of linen in Mesopotamia (Bongenaar 1997:301-412, Zawadzki 2006:58-63).

Some scholars argue that flax was not cultivated in Biblical times, because the texts in Ex. 9:31 and Isa 19:9 are connected to its cultivation and processing in Egypt. Zohary (1967:174) and Borowski (2002:98), however, do not see any reason to doubt the cultivation of flax in Israel in biblical times. Borowski is right when he mentions the flax stalks that appear in the story of Rahab (Jos.2:6).

Archaeological evidence for the cultivation of flax in the Southern Levant.

In the Levant flax is the most commonly used plant fibre. Flax seed has been found in Tell el-Areini Stratum IV, Early Bronze Age (Yeivin1975:95). In the Middle Jordan Valley flax seed has been excavated at Tell Ammata and Tell al-Adliyeh, the finds are both dated to the 10th century BC. During the second half of the 9th century, the numbers of flax seeds increase considerably, suggesting the existence of an irrigation system (Petit 2009:222,224). Twenty-seven samples of flax seed have been excavated in Tell Deir Alla phase IX (IA IIB) (Van der Kooij and Ibrahim 1989:34).

Flax (and also woollen) fabric from the Chalcolithic has been found in the Cave of the Treasurer at Nahal Mishmar (Mazar 1992:73). The Cave of the Warrior, a fourth millennium burial, yielded three separate textiles, a sheet, a rectangular cloth and a long narrow sash-like specimen, all made of linen (Schick 1998). At Beth Shean a 12th-century linen fragment has been excavated (Shamir 1992). At Kadesh Barnea 56 textile fragments have been found, all of them made from linen. The fragments are dated to the Iron Age (Shamir 2007:256-262) At Kuntillet Ajrud in the Sinai, 100 fragments of textile were recovered and most of them were made from flax (Sheffer and Tidhar 1991:3). At the Early Roman site of En Gedi loom weights and fragments of linen have been found (Shamir 2007b:381-390 and Shamir 2007c:587-594).

Dalman (1937:24) names the Jordan Valley and the valley of Ginnesar as places where flax was cultivated. Beth Shean (Skytopolis) was an important centre of production for fine linen, whilst coarse linen was produced in Arbeel (Dalman 1937:24). The Jordan valley was climatically a good place to grow flax. The region of Beit Shean is famous for the production of flax in post-biblical Hebrew literature (Ber. R. 19 (38b), 20 (44a); Koh. R. 1,18 (75a). Also, western Samaria (Anderlind, cited by Dalman 1937:19) and different parts of Palestine and Syria are known for small-scale flax production , but the main producing countries in that period were Egypt and Abyssinia (Dalman 1937:19; Crowfoot 1931:32, fig. 19-21).

In the Hebrew bible flax is mentioned in several places:

As a raw material used for weaving in Deut.22:11; Hos.2:7 and Prov.31:13. Flax stalks were laid on the roof for drying, as mentioned in Jos.2:6. In Lev.13:47-48 and in Ezek.44:17-18 the production of linen clothes is mentioned. Linen, used for belts, is referred to in Jer.13:1, whilst ropes are mentioned in Ezek.40:3 and wicks for oil lamps are referred to in Isa 19:9.

Hemp

Hemp is derived from the stem of *Cannabis sativa*, which is closely related to flax. It is currently known as a fibre to make ropes and cords.

The plants

Hemp is an annual herbaceous plant that comes in two different varieties: one with a high level of THC, delta-9 Tetra Hydro Cannabinol, and this variety is specially bred for its narcotic effects and contains 2-19% THC. The female plants contain more resin in the flowers and top-leaves of the plant, from which marijuana and hashish are made. Fibre hemp has a low-THC level; the European Fibre Research Stations (Le Mans Hemp Institute, France, All-Union Bast Fibre Institute, Gluckhov, Ukraine) and the United States agricultural Department adopted the standard of 0.3% THC, as the concentration that separates non-psychoactive strains suitable for fibre production,[22] The plant consists of a single main stalk, with an external sheath of bast fibre and an interior core of white, fibrous hurd. Fibre hemp is used for a wide variety of purposes, including rope making, textiles, paper, and different production and construction materials.[23]

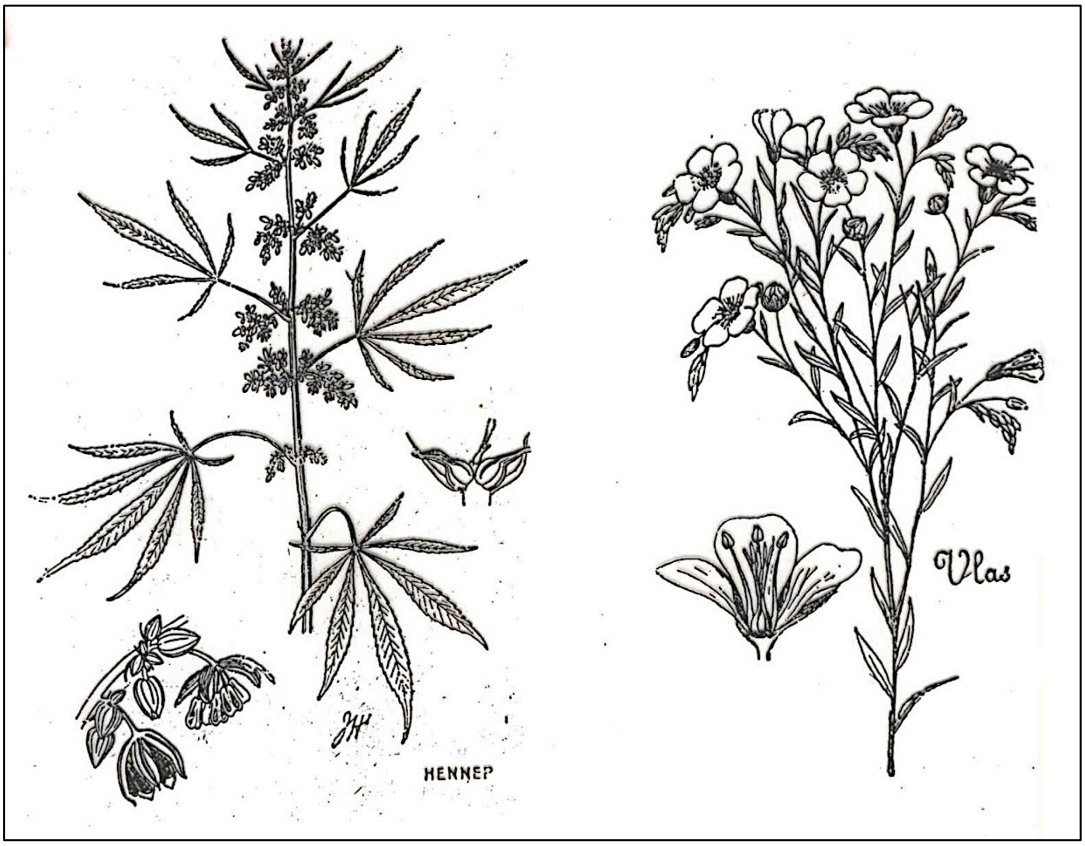


Fig. 2,1. Hemp (Cannabis sativa L.) and Flax (Flax linum L.).

Processing hemp for textile use [24]

For fibre production, seed is sown densely so that growth produces tall slender stems with small bast cells. Plants are harvested 2.5 months after sowing; that is after flowering, but before the

[22] (http://www.druglibrary.org/schaffer/hemp/indust/PHARMAfibre.html < 17-10-2012>).
[23] www.madehow.com/Volume-6/Industrial-Hemp.html <5-8-2011>
[24] Agriculture and food Alberta Government
http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/crop761 <17-10-2012>.

seeds have set (Riddlestone 1996) and when the stalks are about two meters long. Hemp fibres come from the bast cells that provide support for the stem. Processing is necessary to separate the bast bundles from the rest of the stem and then divide them into small enough bundles to make a fine flexible fibre. This is done in 4 steps:
1. Retting (controlled rotting) can be done in the fields over a number of weeks by the action of dew and microorganisms or in stagnant water. Aerobic and anaerobic bacteria and fungi break down the pectin so that the fibre bundles are released from the epidermis and cortex. 2. The dried stalks are then broken in such a way that the woody core is broken but not the long bast-fibre bundles. Each plant produces 8-12 pieces of bast. These bast fibres are about 1.5 meter long. 3. Separating the fibre bundles is often done with a piece of equipment called a decorticator, which consists of crushing rollers. 4. Following decortication or breaking and scutching, the long strands of hemp are hackled or combed with wire pins of increasing fineness and closeness.
Step 4 is very important because it cleans the fibres, removing any remaining non-fibrous stem parts, and separates the bundles of bast cells into finer and finer strands. To be flexible and soft to handle, the fibres must be combed until each strand contains only a few cells. The softest hemp fibres contain the fewest cells. Spinning follows the process of decortication and combing.

Some advantages of fibre hemp over flax
Hemp fibre lasts longer and will not mildew; because of this, hemp has been used for sails for thousands of years.[25] Hemp is a desirable crop to grow because it gives the greatest fibre production per acre and requires the least attention. It not only requires no weeding, but also kills off all the weeds and leaves the soil in splendid condition. One hectare of hemp produces approximately 8000-11000 kilograms of dry biomass.

Hemp history
Hemp originated somewhere in Central Asia where it was known as a food crop. The evidence of hemp fibre used for ropes and textiles is of a later date. Neolithic pots with textile impressions have been found in East Asia. Hemp seeds have been found in Bandkeramik sites in Germany (5500-4500 BC; Barber 1991:16). In Central Europe, hemp was widely used for textiles in the steppe zone from the Neolithic (Barber 1991:17; Shishlina, Orfinskaya and Golikov 2002).
In the Levant only Tell Deir Alla phase IX yielded archaeological evidence for the use of hemp fibre – the find is dated to about 800 BC (see Chapter 6: Deir Alla). There are no literary or documentary sources for the use of hemp in the Iron Age in the Levant but there is evidence for the use of fibre hemp in surrounding areas. From Iron Age Gordion, in Anatolia, small fragments of (probably) hempen cloth have been found (Burke 2010:153). In Egypt hemp rope was used in the construction of the pyramids, to pull the large blocks into place and as a rock-breaker. Workers would stuff cracks with hemp and then wet it down. As the fibre expanded, the rock would break. Pictures from the New Kingdom period show how rope was produced (Veldmeijer 2009). In the 5th and 4th centuries BC there was a major hemp industry in Greece (Barber 1991:18). On Cyprus hemp fibres have been found from the Roman period levels of Pyrgos (Belgiorno, Lentini and Scala 2005). From the Babylonian Talmud we know that hemp was both known and grown to some extent in ancient Palestine and Mesopotamia.[26] It was extensively cultivated in Hellenistic Mesopotamia, where the hemp ropes from Sura were famous.[27]
Hemp is commonly known as the fibre used to make ropes and sacks; in the Middle Ages hemp was used in Europe to make water-resistant and strong sails (Bender Jørgensen 1996). The word canvas (a strong water-resistant cloth) may be connected to the word Cannabis. Pockets of industrial hemp production still exist in Europe, Central Asia and the Far East; the world's largest

[25] 'Flax and Hemp: From the Seed to the Loom.' *Mechanical Engineering Magazine* February,1937. http://hempbasics.com/shop/cms-display/flax-hemp.html <617-10-2012> and http://www.binhaitimes.com/hemp.html <17-10-2012>.
[26] Forbes 1956:59 note 500. a-zal-la, šam azullû = hemp; compare Syr. *azal* = to spin.
[27] Forbes 1956:59 note 501. Bab. Baba Mezia 51a; Bab. Ketub 8b and Bab. Ketub. 67a

producers of hemp fibre at this moment are India and China. Fine hempen cloth is fashionable nowadays and used for clothing and furniture.

Cotton

Cotton is derived from different trees, herbs and shrubs of the genus *Gossypium* belonging to the *Malveceae* family. The cotton tree (*G. arboretum Linn*.) is native to India, Abyssinia and the Sudan. According to Forbes (1956:46) 'It may have been known to the Egyptians whose texts mention a *hair-tree*, which cannot be properly identified.'

Cotton was a latecomer in the Near East and the Mediterranean (Barber 1991:32-33; Forbes 1956:44). Etymological and archaeological evidence for the origins of this plant fibre points to India. Cotton traveled eastwards to China very slowly; its westward journey appears to have happened more quickly. In about 700 BC, King Sennacherib introduced the 'cotton tree' ('the tree that bears wool') to Assyria (Forbes 1956:45; Wild 2003:49). But only in the Hellenistic period did cotton, cultivated in India, Bahrain and Meroë (Sudan), play a role in the Levantine trade of luxury goods (Forbes 1956:45-48). In later periods Egypt and the Levant were famous for their excellent cottons.[28]

Identification of fibres

In the study of ancient textiles the identification of fibres is of primary importance (Peacock 19:183). The fibre morphology of animal fibre is specific; other fibres, in particular those derived from plant stems, are less distinct. When only very small fragments are left, or carbonized fragments, only a skilled textile specialist using a scanning electron microscope can distinguish between vegetal fibres such as linen and hemp. If textiles made of vegetal fibres are found in the Levant, they are commonly identified as linen. But now that hemp textiles have been identified at Tell Deir Alla (see Chapter 6) it seems necessary to re-examine early Levantine textile finds in order to confirm the identification of the fibre types.

2. 2 Thread and spinning

Thread or cordage of some sort were the first of the textile arts (Barber 1991:39). Natural fibres, once obtained, must be transformed into thread suitable for weaving. Spinning is the process of drawing out and twisting together (short) fibres into a continuous strand or thread. Yarn is the general term for any assemblage of fibres that has been twisted together in a continuous strand suitable for weaving, knitting and other textile techniques. Yarn is the most common element used to produce textiles.

There is an old discussion concerning the question of what came first: the spinning of bast fibres or of wool. Modern hand spinners assume that wool was the first fibre mankind would have spun into thread. Their assumption is based on the practical difficulties of spinning bast fibres. Archaeologists, on the other hand, keep pointing out that whenever early thread or string is discovered of which the fibre can be determined it turns out to be bast, often flax.[29] Yarns used in weaving require a certain tensile strength;[30] they have to be strong enough to cope with the strain of being tugged on the loom.

[28] Levantine cotton was yielded from *G. herbaceum Linn*. Egyptian cotton was made of *G. barbadense Linn*. Nowadays Egyptian cotton is still regarded as the highest quality.

[29] Bast fabrics from before 6000 BC have been excavated at Çatal Hüyük and Nahal Hemar. In Egypt flax has been reported from 5000 BC onward (Vogelsang-Eastwood 2000:270), and in Switzerland fine cloth made of bast fibres has been excavated from the 4th and 3rd millennia BC (Barber 1991:41).

[30] Tensile strength is the extent to which a fibre can be stretched without breaking and it is measured in terms of minimum weight required to break the fibre. To determine the tensile strength of any fibre, it is tied to a hook at one end and weights are slowly added to the other end until the fibre breaks.

Spindle types, spindle whorls and spinning
Thread can be spun with no tools at all, by using the fingers to draw out and twist the fibres. This process is very slow and it is difficult to keep the finished thread twisted. Yarn requires tensile strength during spinning to keep the yarn twisted. In order to achieve control of the fineness and evenness of the thread, the fibres must be drawn and twisted with a continuous speed (Gleba 2008:100). The thread has to stay under tension until the twist has been permanently set. The standard solution, worldwide, has been the use of some sort of spindle. Twirling a spindle with thread attached to it is much faster than twisting the thread itself, and the thread can be wound around the spindle to keep the tension until it is set. Crowfoot (1931:10-14) and Barber (1991:42) have investigated the origins of spinning. Crowfoot (1938:8) made a classification of yarn produced in Egypt in her time, and registered with which kind of spinning equipment it was produced. Barber (after Hochberg 1980:25) concluded that the spindle developed slowly from the use of a spinning stick to produce twisted thread and the use of hanging rocks as a flywheel to spin thread. These were combined and developed into an efficient tool: the spindle with a spindle whorl. The yarn is wound onto the stick (the shaft), while the weight of the spindle whorl adds draft to the spinning process. The shaft of the spindle can be made of wood, bone, ivory or metal and the little flywheel or spindle whorl can be made of a heavy material such as stone or ceramic, whilst lighter spindle whorls are made of wood, bone or ivory. The thread was wound on the spindle shaft until the spindle was full.

The spindle
The spindle is the stick to which the spindle whorl is attached. The position of the flywheel (whorl) can be near the bottom of the shaft (low-whorl spindle) or it can be at the top of the stick (high-whorl spindle). When using a light spindle whorl, a short spindle shaft with a maximum length of 12 cm is required (Andersson 2005:47).

Bottom / Low-whorl spindle:
The whorl is located at the base of the shaft and there is either a hook or a notch at the top of the shaft to catch the yarn. The spun yarn is released from the hook of the spindle and wound onto the rod directly above the whorl (fig. 2.2 left).

Top / High-whorl spindle:
A top-whorl spindle has the whorl at the top of the shaft. There is a hook on top of the spindle just above the whorl for catching the yarn. The spun yarn is released from the hook of the spindle and wound onto the rod directly under the whorl (fig. 2.2 right and fig. 2.3). From different depictions we know that the top-whorl spindle was used in Egypt and Mesopotamia. In the recent past the top-whorl spindle was also used in the Levant (fig. 3) but it is not certain if this kind of spindle was also used in the southern Levant in antiquity because no pictures of spinning from this region have been found. Spindle shafts are only seldom found, and when found they do not always show to which part of the stick the spindle whorl was attached. (Barber 1991:56-65).
The high-whorl spindle was used in Egypt where exclusively flax was being spun. In the Levant the high-whorl spindle was used for spinning both flax and wool. In Anatolia (and Europe) flax and wool were spun with the low-whorl spindle.[31] Both spindles were used as follows: When spinning, a length of fibre is drawn out from the mass of fibre or a pre-formed sliver is made (fig. 2.3 left). While the spindle is rotated by twirling between the finger and thumb (or by rolling on the thigh) the unspun fibre is 'caught' by the twirling stick and twisted, and then the spindle is dropped and let swing. This achieves lengths of spun thread and fully uses the increased momentum of the free spindle and its whorl (Forbes 1956:154).

[31] For different ways of spinning see Vogelsang-Eastwood 2000:272.

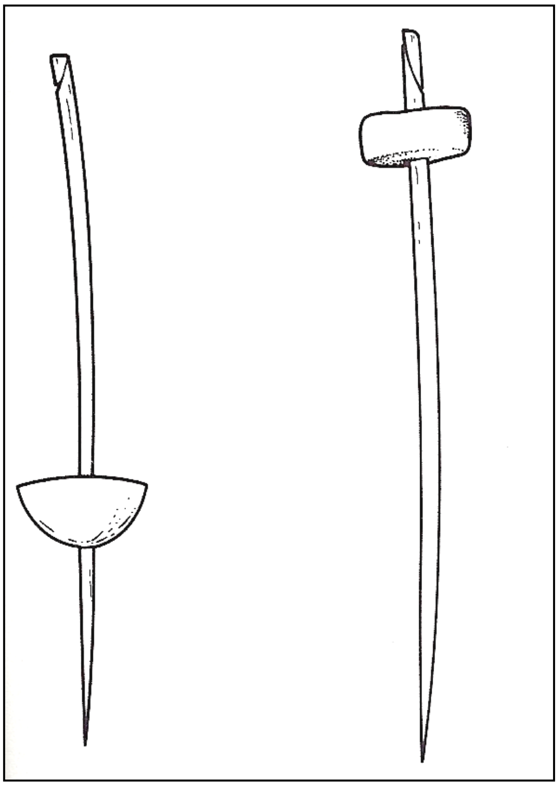


Fig. 2. 2. Low-whorl spindle (left) high-whorl spindle (right). (Barber 1991:65).

Distaff
When spinning material with long curly fibres such as long staple wool one tends to need both hands to draw out the unspun wool. In that case a special stick, the *distaff*, can be used to hold the fibre.

The spindle whorl
The spindle whorl is a round, centrally pierced object. The hole has to be exactly in the centre of the whorl; a double-spayed hole is possible if well centreed, and some adjustments can be made to fit the whorl to the shaft. Barber mentions some padding to fix the whorl to the shaft (1991:52), Liu mentions the use of unspun fibres, wax or resin to fix the whorl tightly to the spindle (1978:90). The use of a lump of mastic to fix the whorl to the shaft has also been reported (Verhecken 2010:265). The shape and weight of the small flywheel varies, as does the material used. Unfortunately it is often difficult to identify any given round object with a hole in it as an actual spinning whorl; it could also be a large bead or a weight (Barber 1991:51).

Practical requirements for the shape of a spindle whorl:
1. Broad enough to maintain the momentum. 2. Heavy enough to draft but not so heavy that it breaks the thread. 3. Symmetrical about a central axis, so as not to introduce an inefficient and irritating wobble into the rotation.
Anything in the shape of a simple round disk or bob with a centreed hole could be used as a spindle whorl. And most spindle whorls, worldwide, are just these simple shapes, perhaps with a bit of decoration to make them pretty or auspicious (Barber 1991:303).

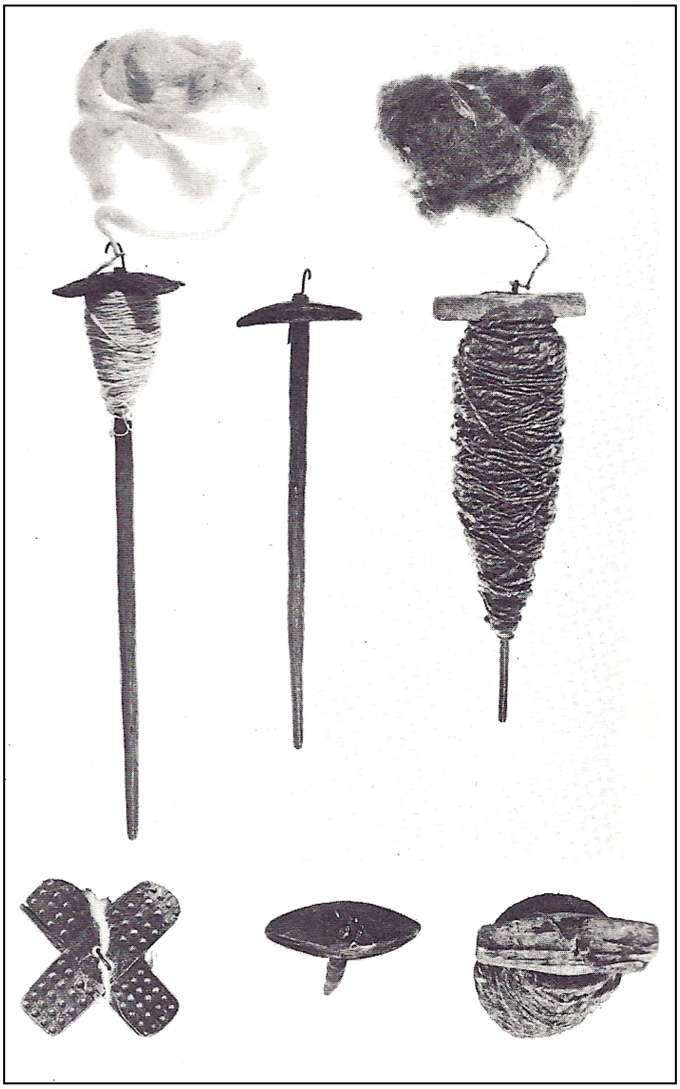


Fig. 2.3. High-whorl spindles from Palestine 1970 (Weir 1970:10, plate 4).

Shape and weight

The spindle whorl functions as a flywheel, and its shape is related to this function. Spindle whorls have different shapes (see typology below). Any round, centrally pierced object, significantly larger than 2-5 cm across, is likely to be a spindle whorl.[32] Frequently the rim of the whorl is notched, probably as decoration.

The earliest known ceramic spindle whorls from the Near East are biconical. Biconical spindles are easy to make according to an experiment by Miller, Leaman and Unruh (2006). Did ancient spinners make biconical spindle whorls just because it was easy, or is there a special utility to this shape? Miller, Leaman and Unruh state that the biconical spindle is heaviest toward the centre, and is therefore most suitable for fibres needing a lot of twist such as bast fibres. As the earliest known spindles are of the biconical type, this would reaffirm the theory that bast fibres were used earlier than wool. Given the absence of preserved cloth, this discovery suggests a new way for archaeologists to infer the type of cloth produced (Miller, Leaman and Unruh 2006:unpaged).

[32] Liu 1978 proved that most round beads the world over are less than 2 cm in diameter, for practical reasons. The smallest spindle whorls from the Middle East are those that were used in the Islamic period, 8 mm in diameter and under 1 gram in weight, used for spinning very fine cotton. (Liu 1978:90-91)

Perforation. The hole in the whorl must be big enough to hold a shaft, mostly ranging from 7-12 mm, occasionally larger (Barber 1991:52). In the research conducted by Liu (Liu 1978:149) it was found that the diameter of the holes in the spindle whorls ranged from 3-10 mm. Research shows that the average diameter of holes in spindle whorls (in the Levant) is 8 mm (Levy at al 2006:715).

Diameter. The diameter is important for the functioning of the spindle: the smaller the whorl, the faster it twirls. A broad whorl gives a long, slow spin for a short time, and was used to make a loose thread with less twist. The small fast spindle whorl was used to produce a tightly spun thread with a lot of twist.

Weight. Andersson (2005:47) showed by experiments that heavier spindle whorls result in thicker yarn (a relatively small weight difference of 5 grams will already affect the fineness of the spun wool).

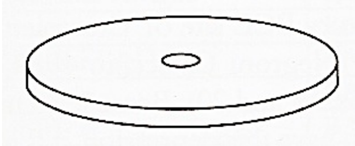
Both diameter and weight influence the 'moment of inertia', which causes the functional spinning of the whorl (Verhecken 2010). There seems to be a small effect from the spindle shaft (represented by the hole in the whorl). This feature has not yet been studied thoroughly.
For short fibres a light whorl is needed, long fibres such as linen/hemp and long staple wool need a heavy whorl; that is a spindle whorl of 100-150 grams or even more, according to Barber (1991:52) and Hochberg (1980:21). However, if the spindle is too heavy the thread will break. Recorded weights for spindle whorls vary between 5-150 grams (Liu 1978:97). The research undertaken at Gilat (Levy at all 2006:714-715) shows an average weight of 27.7 grams with a standard deviation of 23.9 grams.

Spindle shafts in the archaeological record
Complete spindles with a shaft / rod and a whorl found together are seldom excavated, because the shaft, usually made of wood, has not survived. In some cases the shaft is made from bone or ivory and then shafts do survive. Ivory and bone spindle shafts from the southern Levant are more common in Bronze and Early Iron Age contexts than in the later Iron Ages. Guy, who excavated the tombs at Megiddo, reports on the spindles that '…an entirely new conception seems to begin in the LBII, the period of most of the whorls and spindles found in the tombs.' (Guy 1938:170), An interesting specimen is the ivory shaft in two parts, decorated with incised lines, and a whorl consisting of two domes set with the faces together, which were fitted together with a metal pin and mounted on the decorated shaft. Quite a number of other, similar, pieces were found, both shafts and whorls (Guy 1938:171-172, fig.175 pl.84.2-16, pl.95, 41-9). A spindle with herringbone pattern is also known from Late Bronze Age Megiddo (Loud 1948:pl.197:1-13).
In the Southern Levant only a few Iron Age spindle rods/shafts have been found. At Tell Jawa two spindle shafts were found made of undecorated bone, 12 cm and 14 cm in length respectively (Daviau 2002:181). A third spindle rod is decorated with herringbone pattern, and about 9 cm in length (Daviau 2002:182). From Tell Deir Alla, a small undecorated bone rod, measuring 20 cm, is interpreted as a spindle rod (Van der Kooij and Ibrahim 1989:92 and 101 fig. 13). From Tell Khirbet el-Mudayna a spindle shaft has been published, made of undecorated bone (Daviau and Chadwick 2007:311). In Akkadian texts the word *pilaqqum* is used for spindle. Spindles occur as prestigious items made of gold, silver, lapis and rare types of wood, given as royal gifts (Lassen 2010:276).

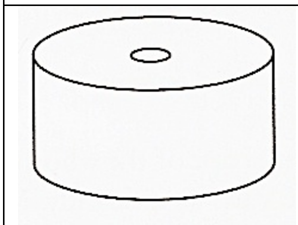
Spindle whorls in the archaeological record
Spindle whorls are made of wood, stone, ceramic, bone, metal or glass. Whorls are nearly impossible to date unless they come from a datable context; decoration or material used to make it is seldom a discernible feature for dating. Until 2008 it was extremely difficult to compare the different types of spindle whorls because there was no general typological description. The typologies used, such as Shamir 1996:149-151, were based on the form of the artefact and not on its function, resulting in very impractical terminologies, descriptions and drawings. Conical

spindle whorls are depicted upside down and therefore called dome-shaped (Forbes 1956:54; Shamir1996:167, fig.22; Daviau 2002:184-185, fig. 2.149:1-2; Petit 2009:fig. 8.37:6; Yahalom Mack 2006:476, fig. 13.36,7,8,9; Yahalom Mack 2007: fig. 12.4). Some authors do not report the weight of the spindle whorls. Both create missing links for textile research. In 2008 Margarite Gleba presented a typology for spindle whorls, based on functional characteristics (Gleba 2008:104). It would be very helpful to use this typology in the Levantine research on spindle whorls because it is a basic typology giving a universal terminology.

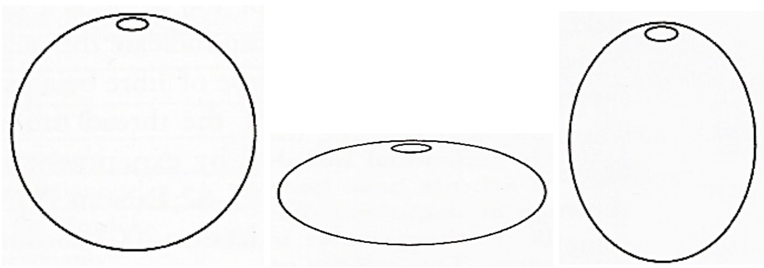
A. Discoid



B. Cylindrical



C. Globuar



1. 2. 3.

D. Conical

1. 2.

C. Biconical

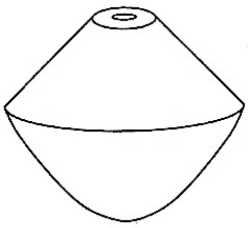


Fig. 2.4. Spindle whorl typology after Gleba 2008:105. (Courtesy of M.Gleba).

Iron Age spindle whorls from the Southern Levant

Wooden whorls are known from Bronze Age sites in Italy (Gleba 2008:101-103, fig.77), and from the Roman period in the Southern Levant wooden spindle whorls are known from Masada (Magness 2002:181; Reich 200:149-151). It is possible that wooden spindle whorls were used in the Levant during the Iron Ages, but wooden examples have not survived in the archaeological record.

Pottery spindle whorls

A biconical pottery spindle whorl has been recorded from Tell Deir Alla (Van der Kooij and Ibrahim 1989:105). From Tel Gezer red and white pottery spindle whorls are known (Macalister 1912), Jerusalem yielded 2 biconical ceramic spindle whorls (Shamir 1996:149). In Kadesh Barnea 23 disc-shaped fired clay spindle whorls have been found together with one dome-shaped whorl and a small biconical spindle whorl (Shamir 2007:265). Tell er-Rumeith yielded 11 stone whorls, one unfinished biconical stone whorl and 4 conical whorls (Chapter 9).

Disc-shaped pottery spindle whorls were often made of reused pottery sherds, from the base of a vessel or jug. Sherds from the sides of vessels were also used. The sherd was trimmed to a roughly circular form, and then perforated. This type is very common: the fractured edge is sometimes left rough, sometimes rubbed smooth. The hole was drilled through halfway, then the sherd was turned round and the hole drilled from the other side, so that it is counter-sunk on both sides. Tell Khirbet al-Mudayna yielded 11 disc-shaped pottery spindle whorls, three of which were made of reused sherds (Chapter 8).

From Jerusalem City of David, Shamir (1996:150-151) published 22 spindle whorls of this type. Beit Shean yielded whorls made of reworked sherds ranging from 7 to 59.5 g.

Tell Jawa yielded 108 similar spindle whorls, the sherds taken from a great variety of vessel types, including red slipped fine ware. The largest example measured 8-9 cm in diameter whilst the smallest were in the range of 3.0 to 3.5 cm. Unfinished and failed whorls are in the same size range as the completed whorls (Daviau 2002:184-185). The spindle whorls of Tell Jawa are an interesting group, but unfortunately no weights are reported.

At Tell er-Rumeith 6 disc-shaped spindle whorls made out of reworked pottery sherds were registered, 2 of which are unfinished and partially pierced, while one has not yet been pierced through (Chapter 9. Tell er-Rumeith).

Bone and ivory spindle whorls

At Kadesh Barnea, one bone dome-shaped spindle whorl was found (Shamir 2007:267).

Tell Jawa yielded one example made of bone, a flat slightly convex whorl measuring 0.38 cm in diameter, fitting on one of the undecorated spindle shafts (Daviau 2002:188). From Tell Deir Alla a bone spindle whorl has been published (Van der Kooij and Ibrahim 1989:99). At Khirbet al Mudayna 2 ivory and 3 bone spindle whorls have been found (Chapter 8).

Stone spindle whorls have been excavated from an Iron Age context. Two alabaster spindle whorls were excavated at Tell Deir Alla (Van der Kooij and Ibrahim 1989:101-102), and a whorl made of green serpentine has also been recorded (Van der Kooij and Ibrahim 1989:106). Diorite spindle whorls are reported from Tell Gezer (Macalister 1912). Limestone, chalk or basalt is often used for spindle whorls: Jerusalem City of David yielded 41 stone spindle whorls made of different kinds of stone: 29 chalk, 4 limestone, and 8 basalt (Shamir 1996:150-151). Others were found in Kadesh Barnea (Shamir 2007:265-267), Tell er-Rumeith (Chapter 9) and Tel Gezer (Macalister 1912).

At Khirbet al-Mudayna 14 stone spindle whorls have been found, made of different kinds of stone and in various shapes (Chapter 8).

Decoration

Some spindle whorls are decorated. The decoration on spindle whorls varies, but often we can see a row of dots or a simple line. Figures radiate from the centre, such as four to seven spokes, or fingernail impressions forming small moons, or chevrons around the hole or aligned chevrons forming little trees. Decoration is always on the surface that is visible while spinning. Some decorations are thought to be owner's marks; in Greece and Italy there is evidence for this phenomenon (Allinson 2004, 2006, 2007; Faxhall 2007).

In Jerusalem four decorated limestone whorls have been found, a conical whorl with concentric circles, a cylindrical whorl with a decorated strip, a whorl with incised lines around the hole and a whorl made of a fossilized sea urchin with a hole drilled through it: the natural lines of the fossil are visible on the whorl surface (Shamir 1996:150). At Tawilan whorls are predominantly of stone or clay and they are decorated (Bienkowski 1995:89). Painted clay spindle whorls imitating the popular and expensive ivory whorls have been recorded from Megiddo (Crowfoot 1954:433 and Stewart 1950:99).

Interpretation of numbers

When the spindle is full (with the spun yarn) it has to be unloaded before it can be used again. It is generally assumed that each spinner had one or two spindles. As it is technically not difficult or time-consuming to unload the spindle, there is no reason to delay rewinding. An exception can be made for places were the spindle was also used as a *spindle shuttle,* to pass the thread through the weaving-shed of the loom. In this case the number of spindles per spinner will be very high. At Troy, Schliemann excavated about 8000 spindle whorls, and such huge numbers of spindle whorls point to the use of the spindle as a spindle shuttle (Barber 1991:304-305). Spinners sometimes put a second whorl onto the spindle (Liu 1978:98), for example when shifting from spinning to plying.

Directions of spinning

There is an aspect of spinning that is geographically determined: the direction of spinning. The direction in which the thread is twisted, whether to the left or to the right, is called the *spinning direction*. The spinning direction can be seen when holding the thread vertically. If the fibres are *S-spun* the thread is twisted to the left and the fibres lie to the right, when the fibres are *Z-spun* the thread is twisted to the right and the fibres lie to the left. This means that if the spindle is turned in a clockwise direction, the twist is S and if the spindle is twisted in an anticlockwise direction, the twist is Z. (fig. 2.5). The direction of spinning is determined by the fibres themselves. Flax fibres curl naturally to the left (S), while cotton, nettle and hemp twist to the right (Z). Bellinger (1963), whilst occupied with the restoration of textiles, found that if the yarns from vegetal fibres were spun in the same direction as the natural twist of the fibre, they would hang together during washing, whereas those spun in a contrary fashion tended to fall apart.

Wool does not have a natural twist therefore it can be spun in both directions. In Egypt it is spun in an S-twist, while in Europe a Z-twist was used. The differences in spinning directions appear to depend on the kind of spindle used. Barber gives an interesting explanation for the origin of this phenomenon. The high-whorl spindle, being rolled along the thigh with the right hand, produces an S-spun yarn. The low-whorl spindle was finger-twirled, and this automatically gives a Z-spun yarn (Barber 1991:66-67).

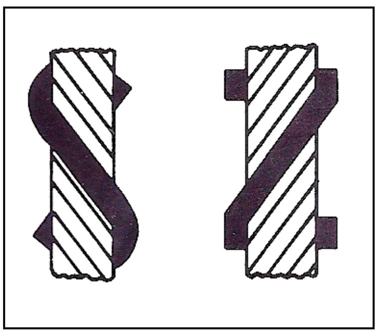


Fig. 2.5. Direction of spinning, the names match the slope of the centre of the letters S and Z.

Spinning of different fibres
Speed is not the only factor involved in the evolution or choice of a spindle; the length and structure of the material to be spun is also a determinant. The optimal shape and weight for a spindle whorl depends on the kind of fibre to be spun. For example, the biconical type, which is heaviest toward the centre, is most suitable for fibres needing a lot of twist. This is the case when spinning flax or hemp, which has relatively long fibres. In contrast, most kinds of wool have short 'crimped' fibres and do not need a lot of twist to be spun into yarn. An exception is long staple wool that has to be spun with a heavier spindle whorl.

Bast fibres need a special way of spinning because the plant fibre is harsh and brittle.
The fibre is long and can be made into yarn in two different ways.
a) Wet spinning: the rove is treated with warm and hot water to dissolve pectin substances, and then drawn by means of special devices to split the thick fibres into elementary strands and produce uniform, fine and durable yarn. The yarn so produced is then spooled and dried and used for making threads or linen cloth. (See also in this chapter: Looped bowls or fibre wetting bowls).
b) Continuous draft: a form of dry spinning in which no pectin dissolution occurs and fibres only become re-aligned against each other on drawing. As a result, the yarn appears to be coarser and less durable.

Experiments
Because so few textiles have survived the ages, many ideas have been suggested to find out what kind of basic material was used to make textiles. Spindle whorl types have been studied to find out whether wool, hair or some kind of vegetable fibre was spun in antiquity.
Generally speaking the form of the spindle whorl does not tell us whether flax, hemp or wool was used, but the weight of the spindle whorl could reveal information about the material spun as demonstrated by experimental studies (Ryder 1968:82-81; Barber 1991:52; Andersson 2003; Andersson Strand 2010:12-15). Systematic spinning experiments have demonstrated that it is primarily the fibre quality, the weight and the diameter of the spindle whorl that affects the spun yarn (Andersson Strand 2010:2).
The research of Orit Shamir on the whorls in Jerusalem gives interesting information about heavy spindle whorls. Attempts to spin with whorls made of reworked pottery sherds (Shamir's type B3h) showed that they might certainly have been used as whorls (Shamir 1996:150). The Jerusalem pottery spindle whorls show a diameter from 2.3 to 7.3 cm and the weight of the whorls is 4 to 88 g. The chalk whorls from Jerusalem are discoid, their weight ranges from 6.5 to 70.1 g, but there are also three extremely heavy weights ranging from 171-195.5 g. Shamir attempted to spin with the spindle weighing 195.5 g and was successful. She concludes that the heavy spindles caused tightly spun threads. Tightly spun threads are suitable as warp threads on the loom as suggested by Ryder (1983:747).

Weight
The tightness of spinning and the thickness of the thread to be spun determine the required weight of the spindle whorl. Thicker threads, as well as two or more threads to be spun together, require a heavier whorl (Shamir 1996:149). Whorls made of light material are used to spin wool and hair with short fibres, while heavier whorls were used for long fibres such as linen or hemp, for long staple wool or to ply different yarns together (Shamir 1996:149; Forbes 1956:152; Ryder 1983:747; Burke 2010:114-115).

Other spinning attributes and artefacts associated with spinning
To ease the spinning work different attributes could be used, such as distaffs, spinningbowls and twiningbaskets.

Distaff
A *distaff* is a special stick to hold the prepared fibre during spinning. Distaffs are usually made of wood; even a simple forked stick would have been sufficient for the task. The rod varies in length between 20-150 cm (Barber 1991:57; Gleba 2008:109). Whilst wooden distaffs have not survived, examples made of luxury materials have been found in tombs, usually forming a set with spindle whorls. Distaffs have not been found in the Levant. Roman sources suggest that distaffs had important social connotations; the material (wood, bone, ivory, silver or gold) and the kinds of decoration reflect social status. A study of distaffs can be found in Gleba 2008:109-122.

Bowls with internal loop handles, fibre wetting bowls or spinning bowls (fig. 2.6).
To protect the fingers of the spinner while spinning harsh plant fibre, and to soften the coarse plant fibres, constant moistening is needed. For that purpose saliva could be used, but water was the more common liquid for wetting plant fibre while spinning. One way to do that was by pulling the rove through a bowl of water, the bowl being of a special type with a loop inside at the bottom; the rove was threaded through the loop handles. Semi-spun and fully spun threads were passed through these loops during spinning in order to keep the threads moist and to place a small amount of tension on the thread (Vogelsang-Eastwood 2000:272). These 'looped bowls' or 'fibre wetting bowls', known as 'spinning bowl*s'*, were identified as such by Peet and Woolley (1923:61). Crowfoot picked up the suggestion (1931:27) but with hesitation because of the lack of evidence. Trude Dothan (1963) analyzed a series of such bowls from Palestine made from pottery; she compared them to similar stone bowls from Egypt. Dothan's study confirms the suggestion of Peet and Woolley because the loops were worn: grooves inside the loops show that yarn was pulled and rubbed constantly through the loops (Dothan 1963:97-99, fig. 1,3. Dothan 1982:762-763). The Palestinian bowls date from the Late Bronze Age and the Early Iron Age, while the Egyptian series begins already in the 12th Dynasty. Dothan concludes that the looped bowls came to Palestine together with the peculiar Egyptian method of adding twist to spliced flax thread. Spinning bowls have from one to six loops or handles set in the bottom of the vessel (Dothan 1963:97-112).
From Egypt we have puzzling depictions of women spinning: a thread emerges from a bowl or basket, goes to her hands and then to a spindle. The women are not spinning the thread, as the continuous thread had already been formed; they are simply adding twist to the pre-existing thread by the turning of the spindle. Stone *fibre wetting bowls* were used for this purpose in Egypt. According to Dothan the earliest examples are from the 12th Dynasty (1973-1795 BC) (Dothan 1963:101). But earlier examples are known, such as the spinning bowls from several Middle Kingdom (c. 2025-1750 BC) tombs at Beni Hasan (Vogelsang-Eastwood 2000:272-274 and fig. 11.4). More and more vestiges of this practice have turned up in Bronze Age Crete (Early and Middle Minoan c. 2200-1500 BC) at Mytros, Drakones, Palaikastro, Kommos, Arkhanes (Barber 1991:73-77). In modern Japan comparable bowls are used for wetting nettle fibre while spinning[33] (Barber 1991:73).[34]

Doubling of thread
Spinners frequently doubled their thread; this could be done either on a spindle or by hand. The yarns are usually doubled or plied in the opposite direction to that in which they are spun. Spun yarn can be doubled and twined together. While twining, the ready-spun yarn was coiled and the bobbins were kept in a basket or in a pot to prevent them from jumping around. It is thought that baskets were usually used for this purpose, known as twining baskets (Barber 1991:70-77).

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[33] Nettle is a bast fibre.
[34] Bowls with internal loop handles have also been found in Mesopotamia, but classified as kitchen utensils rather than textile tools (Strommenger 1970:66 and 69 cited by Barber 1991:71). Barber 1991:70-77 discusses the different possibilities of how the tool spread and evolved over time.

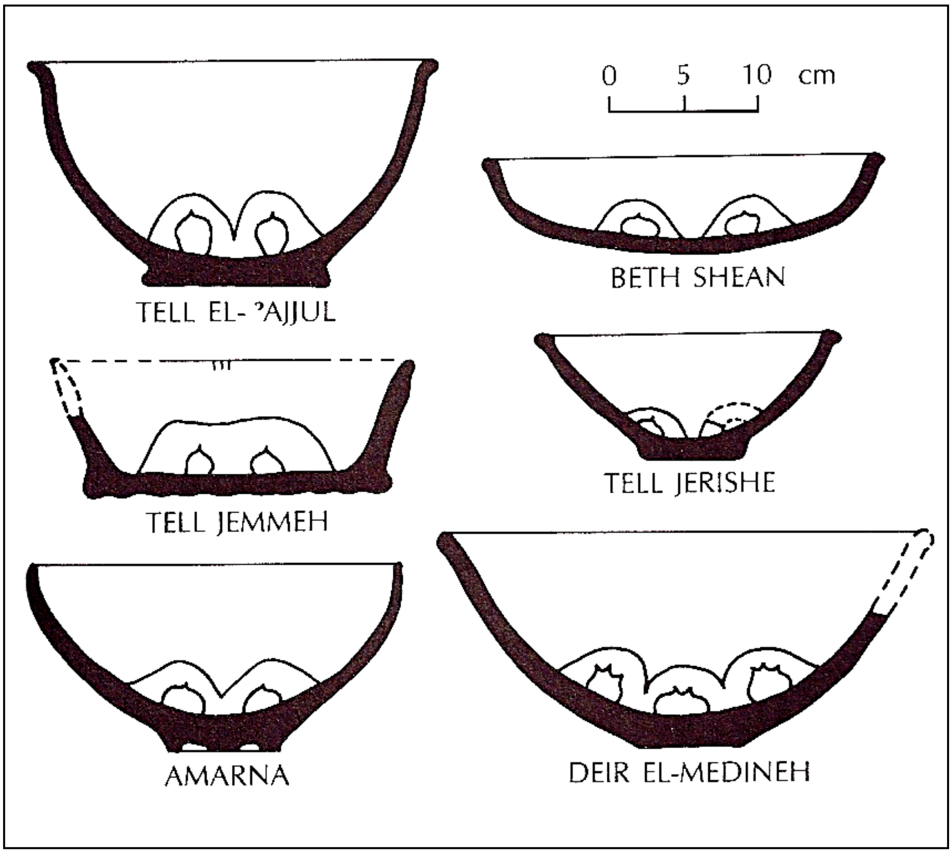

Fig. 2.6. Fibre wetting bowls/ spinning bowls (Dothan 1963 fig. 1 and 3).

2.3 Cloth and weft

Weft is the way in which the cloth is made. There are various techniques to produce weft on the various looms, each technique giving a different type of cloth.

Weave binding systems [35]

The simplest form of weaving is the tabby weave. The tabby weave or plain weave (fig. 2.7) is the simplest weave based on the basic binding system of a unit of one warp thread and one weft thread, the warps slightly outnumbering the weft with both warp and weft visible. All other weaves are variations upon this basic weave, and some of these can be extremely complex.

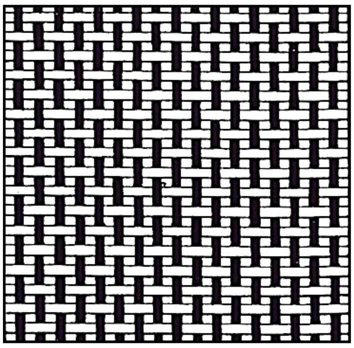
Fig. 2.7. Tabby weave.

[35] Only a few general binding systems are mentioned here. For a detailed overview of basic weaves see: Hodges 1976:137-146. A historical development of textile weaves can be found in Barber 1991:126-214.

Balanced weave or balanced tabby weave (plain weave or simple weave) (fig. 2.8) is the uncomplicated tabby weave in which warps and weft have the same count, with both warp and weft visible.

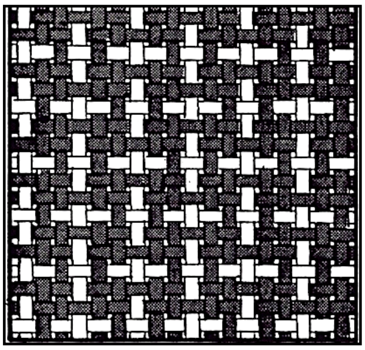
Fig. 2.8. Balanced tabby weave.

In the warp-faced tabby weave (fig. 2.9) the warp threads are the visible part of the fabric, the warps outnumbering and concealing the weft.

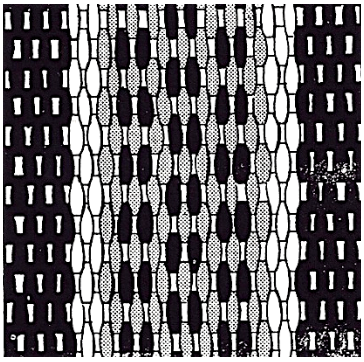
Fig. 2.9. Warp-faced tabby weave.

In the w*eft-faced tabby weave* (fig. 2.10), the weft threads are the visible part of the cloth, the weft outnumbering and concealing the warps.

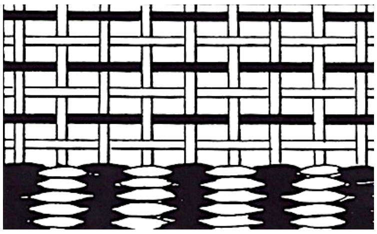
Fig. 2.10. Weft-faced tabby weave.

Archaeologists can seldom tell warp-faced tabby weave from weft-faced weave because the surviving scraps of cloth are so small. Barber (1991:127) suggests using the term faced weave as a generic term. Basket weave is a plain tabby weave in which the warp and weft threads move in groups of two or more, with numerous variations.

Twill weave is a weave with a basic binding system based on three or more threads in the weft and three or more threads in the warp. Both weft twills and warp twills exist. The numerical ratio of the threads in the weft and the warp is often given as 2/1, 2/2 or 3/1 etc., the point at which the threads cross over create a diagonal pattern.

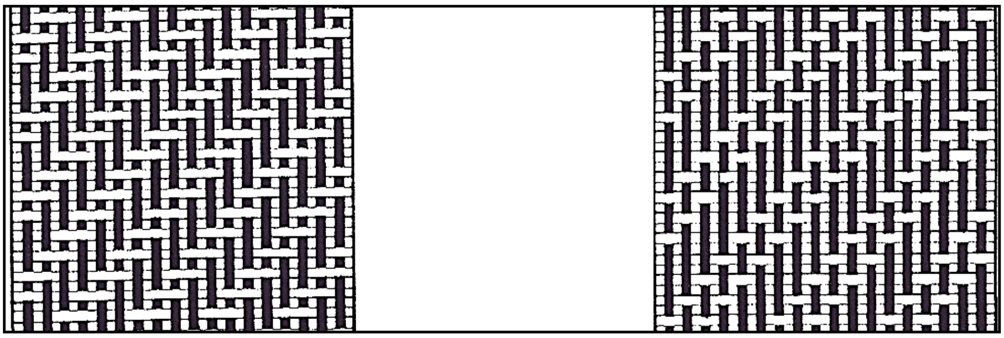

Fig. 2. 11. Twill weave: left 2/2 twill, right 3/1 twill.

The twill weave and the *tabby weave* lead to a range of possible variations and there are many more binding systems, which will not be discussed here because they have never been found in the southern Levantine archaeological record.

Only a limited variation in weft types has been recorded from the Levant during the Iron Age, because few and only very small textile fragments have survived and because textile fragments are often not analyzed and published.
Faced weaves developed in Mesopotamia, Syria and the Levant(Barber 1991:210), where the weft or the warp threads are visible in the cloth, forming a pattern of stripes or diagonal ribbing. Contra Barber (1991:127), Sheffer and Tidhar (1991:22) state that textile fragments can be diagnosed as being weft- or warp-faced weaves. Most woollen weaves in the Levant, Syria, Greece and Egypt are weft-faced weaves*,* typical of woollen fabrics from all periods (Sheffer and Tidhar 1991:22). A survey of published cloth fragments from different periods shows that the weft-faced weave is indeed dominant. It can be seen in most of the fragments from the Chalcolithic Cave of the Treasure (Bar-Adon 1980:153, 175) and Iron Age Kuntillet Ajrud (Sheffer and Tidhar 1991:22), the items from Murrabaat (Crowfoot and Crowfoot 1961:54-58) and the Qumran Cave of the Letters (Yadin 1963:188). It is similarly typical of the eighth century BC woollen items from Gordion in Turkey (Bellinger 1962:14), Enkomi, Cyprus (Granger-Taylor *etc.* 1988:149) and is also the predominant technique for woollen textiles from the Syrian sites of Dura Europos (Pfister and Bellinger 1945:2), Halabiyeh (Pfister 1951:30-32) and Palmyra (Pfister 1934:33-35), as well as in Egypt at Karanis (Wilson 1933:9). In the Moabite Iron Age site of Khirbet al-Mudayna, a cloth fragment was found made of wool in plain tabby weave (Chapter 8). Bast fibres are usually woven in plain or tabby weave, with a few variations such as balanced tabby and warp-faced tabby, as can be seen in the material from Kadesh Barnea (Shamir 2007:255) and the hemp fragments from Tell Deir Alla (see Chapter 6; Boertien 2004:306).

The separately woven starting border is a typical distinguishing phenomenon for cloth woven on the warp-weighted loom (Crowfoot 1951:18, fig.3 and plate VII: 21; Hoffmann 1974:151-152,154 and 178; Hald 1980:203,205-208; Browning 1988:29; Raeder Knudsen 1998:79-84; Raeder Knudsen 2010; Cecchini 2000:211). [36]
The starting border served to keep the warp evenly spaced on the loom and prevented the drawing in and the crowding of the warps (Crowfoot 1955:22, Bellinger 1962:11). According to Hoffmann, starting borders can be divided into two groups, woven starting borders and corded

[36] The textile traditions in Egypt are different from those in the Levant. That can be deduced from the textiles themselves but also from the looms that were used. The warp-weighted loom seems not to have been used in Egypt, as there are no depictions of this kind of loom and no loom weights have been found. The only exception is el-Lisht, where Mace (1922) reports 'weights by the dozen', arguing that the Egyptians must have used weighted looms; most scholars, however, question the use of these weights as loom weights – see further the discussion in Kemp and Vogelsang-Eastwood 2001:392-394.

ones (1974:154). Woven starting borders are made of a narrow separately woven band produced in the card weave technique. Corded starting borders are made with a separately produced cord, interlaced with the warp threads at the beginning of the weft. Both kinds of starting borders are interwoven with the warp threads at the top of the warp-weighted loom. Such a distinguishing border has been found at Kuntillet Ajrud (Sheffer and Tidhar 1991:4-5).

2.4 Sewing and embroidery

Sewing is connecting pieces of cloth to each other using thread and a needle. Sewing served different purposes: reinforcing edges, lengthening the fabric by joining additional pieces or attaching patches.
Different sewing stitches are known but little is left in the archaeological record. In the southern Levant two collections of Iron Age textiles have been found that d0 show the remnants of sewing.
From the textiles found in Kuntillet Ajrud, different sewing stitches could be determined, such as the running stitch, overcast stitch, the seam stitch, the slipstitch and the hemming stitch (fig. 2.12). Sewing thread was found together with the textiles (Sheffer and Tidhar 1991:8-10).
Different stitches could be discerned on 15 textiles from Kadesh Barnea: regular and irregular overcast stitches, hemming and seaming stitches. The sewing threads were made of two s-spun linen threads plied together into a strong and thick Z-plied thread (Shamir 2007:260-262).
Patching was used to repair worn or damaged pieces. The worn or damaged area was removed from the fabric and a patch of the exact shape and size inserted. In the textiles from Kuntillet Ajrud the patching was carefully done (Sheffer and Tidhar 1991:8), while in Kadesh Barnea carefully patched items were found together with carelessly sewn patches.
Embroidery is decorative sewing usually using a thread in a different colour to the cloth. This means that embroidery requires separately dyed thread. No such items have been found at Iron Age sites in the southern Levant.

Needles are used to draw thread through fabric in order to link two pieces of fabric or to sew a hem or attach a button or bead. Needles are pins with eyelets, but not all of the numerous varieties of pins with eyelets can be regarded as needles. This word must be restricted to implements used for sewing. Non-perforated but otherwise similar strips of bone were possibly used for pricking holes in skins or other tough material. In the Levant Iron Age needles were generally made of flat strips of bone, tapering towards the tip, and perforated at the broader end (Macalister 1912:79-80). Metal needles were made by hammering out one end of a metal rod until it was thin enough to be bent over the node of the rod, in order to create the eye of the needle. Iron or bronze needles have been reported from Iron Age Levant (Van der Kooij and Ibrahim 1989:98), from Tell Jawa (Daviau 2002:201) and Megiddo (Loud 1948:pl.186, 187, 219:6-9).

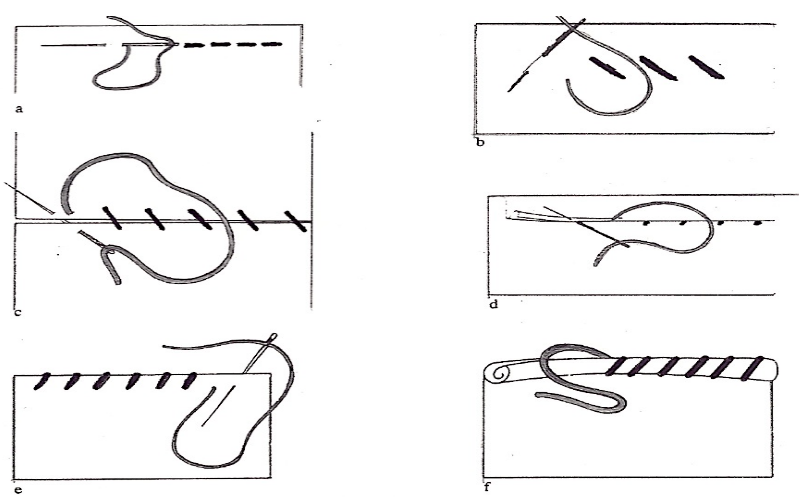

Fig. 2. 12. Sewing stitches: a. Running stitch; b. Overcast stitch; c. Seam stitch; d. Slip stitch; e. Hemming stitch; f. Rolled stitch (after Sheffer and Tidhar 1991:9).

2.5 Colour and dyeing

"If we find that little distinction was made between such colours as violet, scarlet and purple this is not due to any colour blindness of the ancients but to the uncertainty of the results of dyeing in those days, which made reproducibility almost unattainable*."* (Forbes, 1956:99).

This remark, published fifty years ago, is still valid in the research on dyeing. The same problem can also be found in clothing used in the present time. The ingredients of the dye, the method of preparation, the proportions and degree of concentration, the temperature and duration of the dye-bath all vary and so yield different results.

Cleaning and bleaching

Before dyeing, textiles had to be cleaned and washed. A lot of water is needed to rinse wool: about 40-50 times as much water as the dry weight of wool, resulting in a minimum of 40 l water for 1 kg wool. These amounts are of interest when interpreting archaeological finds related to dyeing, such as basins. During the cleaning and bleaching process different substances were used as detergents[37] to dissolve dirt and oil: bran, urine, various kinds of earth (fullers earth), natron, potash, decoctions of *Concolvulus scamonia* and several species of *Cucumber*. Some of these detergents used in the cleaning process were slightly alkaline and could influence the dyeing process (see below).

Natural colours

The natural colours of linen and hemp come in all shades of white. Usually fine linen was bleached by exposing the fabrics to direct bright sunlight. Sheep produce wool in many shades between white and dark brown. Goat's hair ranges in colour from black, grey and brown to white. The natural colours of wool and goat's hair were put to use. Various dyes could be used to obtain colours other than white, brown and black.

The tinting of fabrics

The essential process of dyeing changed little over time. Typically, the dye is put in a vessel of water after which the textiles to be dyed are added to the vessel. The mixture is heated and stirred until the colour of the textile has changed. Textile fibre may be dyed before spinning (dyed in the wool) but most textiles are yarn-dyed or piece-dyed after weaving.

Over time people have dyed their textiles using common, locally available materials. The simplest way to colour yarn or cloth was to soak it in red-brown iron-containing mud. Shades of orange, yellow and brown could be obtained in this way, depending on the exact colour of the earth that was used.

The term *dye* is used for any substance used for the tinting of fabrics, most of which are of organic origin. Plant-based dyes such as woad, indigo, saffron and madder were grown and traded commercially in the ancient economies of Asia and Europe. The almost mythical and famous invertebrate dyes such as Tyrian blue and crimson Kermes, were the most expensive. Scarce dyestuffs that produced brilliant and permanent colours were difficult to find, and therefore both the dyes and items dyed with them were valuable trade items.

Ochres are mixtures of quartz sand, clay and iron oxide in colours that range from brown and yellow to greens, reds and violets.

Lakes are pigments made by the precipitation of an organic colouring matter upon a base or substrate, usually an insoluble, semi-transparent, inorganic material such as aluminum hydrate or calcium sulphate. Such lakes were sometimes used in ancient dyeing practice.

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[37] Detergents are water-soluble cleansing agents that combine with impurities and dirt to make them more soluble; detergents differ from soap in not forming a scum with the salts in hard water.

Pigments are colours in a powdered form that are mixed with a substance (like oil or egg) to make paint. Pigments should be distinguished from *dyes.* Pigments were used to colour cloth but they do not make a permanent chemical bond with the fibres and could easily chip off.

Natural dyes can be obtained from mineral, vegetable and animal matter. The use of minerals to colour cloth appears to be the oldest technique. Substances such as red or yellow ochre (iron hydrate oxide or iron oxide respectively) were smeared onto the surface of cloth to give it a permanent colour (Vogelsang-Eastwood 1993:62). The largest groups of organic dyes are derived from plants of various types. Vegetable dye can be subdivided into three different types: plants, lichens and seaweeds. Dyes can be extracted from different parts of the plant: the root, stem, leaves, flowers, fruit and berries. In some cases different colours can be extracted from plants depending on which part of the plant was used and whether the plant was used fresh or dried (Vogelsang-Eastwood 1993:63).
Dyes of animal origin are restricted to two main types: dyes obtained from shellfish and dyes obtained from insects. A small number of shellfish have been used as a dye source; the most famous example is the mollusc Murex to produce royal purple. Some of the most valuable dyes come from insects such as Kermes and Cochineal. Cochineal (coccus cacti) produces carminic acid. Kermes is an insect breeding on oak trees, and the dye comes from the unlaid eggs of the insect that contain kermesic acid, which gives vermilion red.

Coloured textiles
What can be proven in detail about ancient dyes is very little, and most of what is written on the subject raises possibilities. Owing to the circumstances in which textiles are found, most finds are carbonized and thus the original colours are not preserved.
Research on textile fragments from Tell Deir Alla and Khirbet al-Mudayna (Chapters 6 and 8) revealed no traces of colour. The fifty textile fragments from Kadesh Barnea were carbonized and thus no colours were left (Shamir 2007:257). Textile fragments from Kuntillet Ajrud, however, have preserved some of their colours, thus far the only Iron Age evidence for the use of dye in the Southern Levant. The dyed textile fragments from Kuntillet Ajrud were studied by S. Edelstein and D.H Abrahams of the Dexter Chemical Corporation and published by Avigail Sheffer and Amalia Tidhar in 1991. A hundred fragments of textiles yielded five fragments with blue linen threads and one fragment with both blue linen and red wool decoration. Of the blue threads, the two largest fragments were dyed with true indigo (*Indigofera tinctoria)* and the others with woad *(Isatis tinctoria).* The red wool threads were identified as being dyed with *Alizarin*, a red dye produced from the Madder plant (Sheffer and Tidhar 1991:7-8). The dyed textiles from Kuntillet Ajrud are unique in the Southern Levant, the only known evidence of different dyeing techniques and colours in the Iron Age colours. The dyes and dyeing techniques are discussed below.

Dye workshops
Many mordants and some dyes produce strong odours, and because of this industrial dye-workers were often isolated in their own quarters within the settlement or located on a hilltop outside the settlement. Distinguishing dye works from other kinds of industry archaeologically is complicated. Installations that might have been used for dying are subject to discussion. For example, Albright interpreted installations from Tell Beit Mirsim as 8^{th}-7^{th} century dye works (1943:55-62). However, Amit (1979:114-117) reinterpreted the function of the complex and concluded that the installations were used as olive presses. Barber (Barber 1991:241) thought the stone installations were dye vats but Borowski interpreted the stone vats as being basins for olive beam presses (Borowski 2002:123). To complete the picture and to find the actual Iron Age dye works, features and installations with remnants of dyestuffs will have to be examined/re-examined in context.

Dye processes
The simplest method of dyeing is to put the entire piece of finished cloth or yarn into the dye pot (Robinson 1969:20 Barber 1991:221), but many other ways of dyeing are also used:

Smearing: The colourant is literally smeared or spread onto the cloth. The technique is commonly used with mineral pigments such as ochre or iron-bearing mud (Vogelsang-Eastwood 1993:67).
Painting: Hand painting of cloth is one of the oldest methods to decorate material. In some cases the colourant is applied directly onto the cloth with the hands or with a brush. In other cases, some form of resist technique is used whereby the areas to be left undyed are painted in with wax (Vogelsang-Eastwood 1993:68). This method is often used for felt carpets (Dalman 1937:8).
Wool was mostly dyed before spinning (Sheffer and Tidhar 1991:8).[38] Wool is much easier to dye than linen because the natural acid of the animal fibre acts as part of the mordant. It is difficult to dye linen and other bast fibres because the bast fibres do not take dye easily. Dyeing linen necessitates the use of a mordant to unite the colouring matter permanently with the textile fibres (Sheffer and Tidhar 1991:22).

Dyeing techniques
Different ways of dyeing can be used to add the colour to a textile, depending on the fibre material, the sort of dye used and the intended colour. *Substantive dyes* are dyes that can be applied to the fibres or the cloth without any intermediary, such as a mordant; these dyes can be used both to smear the dye directly onto the cloth, or as vat dyes. Substantive dye techniques can be divided up as follows:

A. Direct dyeing
Dry plant matter (or twice the amount of fresh matter) is soaked in water for one night. Then the substance is boiled for 1-2 hours. Depending on the material used, the wool is added directly or the boiled plants are wrapped in a sack. Then the wool is left in the dye-bath for 1-3 hours, followed by rinsing and/or washing.

B. Pre-stained dyeing
In pre-stained dyeing, alkaline metal salts such as iron, copper and potassium are mixed with hot water; 40-50 times the amount of water is added to the dye bath before the uncoloured wool is added. The pre-dyeing lasts for 1.5 hours; then the wool can be taken out of the bath. To intensify the colour the stained wool can be left wrapped in a piece of cloth for some days. Then the normal dyeing process follows.

C. Dye-bath with a developer
Wool is dyed following the methods A-B-D or E; then the temperature of the dye bath is lowered and metal salts are added to the dye bath. The dye with the developer is heated again and after 30-45 minutes the wool can be taken out of the bath. Then rinsing and washing follows.

D. Dye-bath with aids and/or stains
Metal salts are mixed with water and added to the dye bath. Then the uncoloured wool is wetted and added to the bath. The temperature is kept at 90-100° C for 1-2 hours; then the wool can be washed and rinsed.

E. Acid dyeing
Plant matter is heated and water added to the dye-bath when the temperature is about 40-50° C. The acid substance is added, followed by the wool. For 1-1.5 hours the temperature is kept at 90-100°C. If necessary this process can be repeated or followed by method C to intensify the colour.
Apart from substantive dyes there are dyes that are used as vat dyes. A small number of dye plants only release their colourant after the plant material has passed through a complex series of processes. These dyes are soluble in alkaline liquids and are transformed into leuco-compounds that fix onto the fibre by oxidation in the air without the use of a mordant. The preparation of such

[38] Based on Yadin, Y. *The finds from the Bar-Kokhba period in the Cave of the Letters*. Jerusalem, 1963 and Weir, S. *Spinning and Weaving in Palestine*. London 1970. (Plate 5).

dyes is a more complicated process, but the resulting dyed fabrics are exceedingly fast to light and water (Robinson1969:23-24).

Adjective dyes are indirect acid dyes; they are the most common form of dye, requiring the use of a metallic salt or mordant as part of the dyeing process.

Resist dyeing is a technique that prevents the dye taking in a particular area on the yarn or the cloth. The various methods of preventing the dye from taking colour are:
- using wax or some sort of paste (batik)
- folding the yarn or cloth to make the penetration of the colour difficult (tritik)
- binding the yarn or cloth to prevent the colour from penetrating the bound parts (ikat or tie- dye)
- using foreign bodies such as stones or leaves to prevent the colour from penetrating the cloth.

Mordants and acids

Pigments are colourfast to light to some degree but they do not remain colourfast in water, humidity or wear. Thus many attempts were made to bind pigments to fabrics (Robinson 1969:20-21). Most organic dyes require certain additional ingredients to make them colourfast (Gleba 2008:76).

Chemical substances can affect the different raw materials used in textile production. Since bases may more easily hydrolyze peptide bonds than acids, wool and silk are affected by bases and not by acids. It is because of this that wool and silk threads break up into fragments and ultimately dissolve in alkaline. In other words, alkalines decrease the tensile strength of animal fibres (wool and silk). Vegetable fibres (cotton and linen), on the other hand, consist of long polysaccharide chains in which the various glucose units are linked by ethers. Since ethers are hydrolyzed by acids and not by bases, vegetable fibres are affected by acids but not by bases. In other words acids decrease the tensile strength of vegetable fibres. Plant fibres and animal fibres react differently to alkaline and acid. A weak acid environment is needed to dye wool. Plant fibres such as linen and hemp are somewhat sensitive to alkaline but very sensitive to acids. Therefore both chemical reactions are used in textile dyeing processes.

Alkalines

Some dyestuffs do not penetrate into fibres and therefore the textile will not take colour easily. Bast fibres are more difficult to dye than wool because they need an alkaline environment to take the colour. Therefore at a very early stage of textile history the dyer must have discovered the action of *mordants*. The word *mordan*t comes from the Latin word *mordere* which means *to bite*. The mordant *bites* into the fibre, allowing the dye to penetrate more fully into the cloth. A mordant is an inorganic oxide that combines with a dye or stain and thereby fixes it in the material. *Mordants* are used to fix natural dyes to fabric and help the colours to adhere to the fibre. Mordants may have been discovered by chance during attempts to find good detergents for washing wool or linen. Some detergents used in the cleaning process were slightly alkaline and thus helped to dissolve acid dyes to obtain a proper dyeing solution. The most common mordants were iron, alum, and copper. The material to be dyed is first mordanted in the chosen metal or salt, by heating it in water with the mordant. Then it is transferred to the dye bath and again heated to obtain a permanent, rich colour. The fixing agent is caused to precipitate onto the fibres along with the dye by an alkali. Mordant and dye then form a lake that adheres strongly to the fibre and thus gives bright and durable colours. Mordants can be used in different ways. When the fibres or cloth are first treated with chemicals, we are dealing with real mordanting. But often textiles are first stained in dye solutions or in plant juices and only then dipped in water containing iron salts, after which they are exposed to the air. Mordants were used for several dyes such as purpurine, kermes, madder, saffron, archil and weld. Ochres could also function as mordants.

Acids

Animal fibres such as sheep wool and goat hair are sensitive to alkaline – it makes wool hard and tough. But in an acid environment wool and hair stay soft and pliable. The use of acids as pH modifiers was also important because wool and some dyes take better in an acidic environment.
Here a special acid has to be mentioned, namely formic acid from ants. Formic acid has many industrial uses, in textile and leather manufacture, as an industrial solvent, and as an intermediate. This acid could have been used in textile production in the Levant. A find from Deir Alla points in this direction: a jar containing thousands of ants and some wool lice and centipedes originally floating in liquid. It is not clear if the ants were put into the pot together with the liquid, were enticed by the liquid on purpose, or entered the jar on their own (Van der Kooij and Ibrahim 1989:41,82 and fig. 41 showing the ants, wool lice and centipedes; Chapter 6).

Alkalines	***Acids***
Urine. Urine is essentially a detergent and solvent. Urine decomposes into ammonia, giving an alkaline environment.	*Acid water* Wheat bran soaked in water. Wheat bran mixed with boiling water and kept for 4-5 hours in a warm place gives acid water. Acid water is used in combination with the dye *cochineal*.
Lye is a strongly alkaline solution, especially of potassium hydroxide, used for washing or cleansing.	*Vinegar* Made from sour wine (mixed with water).
Potash (potassium) Potassium is a soft, silvery-white reactive metal of the alkali metal group. It is found in potash. To make potash, vegetable ashes are leached and the evapourating solution in iron pots is the potash.	*Formic acid* Ants, classified as *Formicidae,* belonging to the order *Hymenoptera,* are insects with a segmented body covered by an exoskeleton. They secrete an acid in their bite or sting. Formic acid is the simplest carboxylic acid, an organic acid that contains one or more carboxyl groups (chemical formula HCOOH).
Copper-vitriol/copper-sulphate. Copper-vitriol consists of true blue crystals; it is soluble in water.	
Iron-vitriol/ green vitriol/ iron-sulphate. Iron-vitriol consists of greenish crystals that are soluble in water. When left in contact with water it weathers and a yellowish-brown crust appears; then the iron-vitriol loses its power.	*Alum* Different kinds of alum occur in clays and salts. It is soluble in water, and has a sweetish taste. When heated it liquefies; and if the heating is continued an amorphous powder remains. Alums are astringent and acidic.
Soda ash	

Table 2.1. Alkalines and acids used in dyeing.

2.6 Appendix: Some colours and dyes used in the Levant during the Iron Ages

The following is a list of some of the known dyes and dyestuffs used in the Levant.[39] The dyestuffs available in the Iron Age[40] are marked with an asterisk*.

Introduction

Red, especially when taken in a broad sense to include *browns* and *oranges,* was clearly a popular textile dye colour right from the beginning. Blue seems to be to be the next colour to establish itself widely, with yellow soon after. Green apparently came later, generally the result of combining blue with yellow (Barber 1991:225). Light will remove or bleach out the natural colours of plant fibres, making it extremely difficult to reconstruct exactly the original colours used in antiquity.

Red and pink

In the past people were well equipped in the field of red dyes (Forbes 1956:100). Reds could be made out of insects, lychens and plant matter.

Insect dyes

Most dyes were of plant origin, but two insect dyes were known in the past: *cochineal* and *kermes*. Due to limited entomological knowledge in the past, *cochineal* and *kermes* were often confused because both are insect dyes producing an intense red colour. Cochineal gives a purplish red colour while Kermes gives an extremely bright and intense red colour.

Cochineal carmine is an insect dye made of the dried bodies of different scale insects (*Coccoidea*) breeding on different kinds of cactus plants: *Coccus cacti L.* breeding on *Aeluropus leavis* or on *Dactylis litoralis* and a *Coccus* breeding on *cactus cochenillefera.* The insects produce the true *cochineal* dye. The colouring matter is carminic acid: crimson in the form of aluminum, tin or calcium salts. The cactus *cochenille fera* was grown near Nablus, and the insect producing red dye was fed on it (Forbes 1956:102). A true cochineal (carminic acid) red was also produced from the female bodies of an insect breeding in certain grass species in the Ararat valley (Dalman, 1937:76-89; Kurdian 1941:105-107).
(Hebrew: *karmil*; Greek: *kokkinos*, *kokkos*; Latin: *coccus*)

*Kermes** is a scale insect (*Kernococcus vermilio Planch.and Kermes echinatus)* breeding on oak trees. (*Querqus coccifera L.)* The *Querqus coccifera* is native to the Mediterranean coast (Forbes 1956:102). In the Southern Levant *Kermes echinatus* is found in the coastal plain in Israel (Amar 2005). The dyeing matter is kermesic acid.
The dye is produced by the female insects when their bodies contain eggs; the unlaid eggs inside the insects contain the colouring matter. These small berrylike insects look like tiny grains on the branches of the Kermes oak. In April and May the eggs begin to develop, and they are harvested in May and June. Before the eggs are hatched they are killed by vinegar vapour or by immersion in this liquid. The dried red-brown grains are kept in the liquid or in the form of cakes. Kermes therefore is referred to as 'the grains'. Classical authors thought the animal was a worm, *vermiculus;* the name for the red colour vermillion is derived from this word. 'The grains', which have a rather pleasant smell when crushed, yield a carmine-red dye soluble in water and alcohol.
Recent chemical analysis has identified the scarlet dye produced by the scale insect *Kermes echinatus* as the *shani* (red in Hebrew). *Kermes echinatus* is found in Israel, which suggests that the origin of the *shani* (red) colour mentioned in the Hebrew Bible could have been local and that this dye was not imported from abroad, as some scholars have assumed (Amar 2005:1080-1083). Kermes was applied as a vat dye using alum or urine to fix it to the fibre. Kermes was rarely used

[39] The information on dyes is mainly taken from Dalman 1937: 70-89; Forbes 1956:98-148; Barber 1991:223-243 and Vogelsang-Eastwood 1993:62-7.
[40] Based on Brunello 1973:47-62; Weippert 1987:137; Borowski 2002.

for linen, it was used for dyeing wool and leather; though less expensive than purple it remained a luxury dye.
(Hebrew *shani* ; Greek: *baphike*; Latin: *coccus* (Arab: *sabr*)

Red dye derived from lichens
Lichens are double organisms, built of seaweed / alga and a fungus. The fungus is the main part of the organism; it forms fungus threads. The seaweed lives between these threads, and together they produce various acids that form the dye, such as blue litmus.

Archil / Orchil (*Orseille or Litmus*) Archil is a purple dye derived from Orchil lichens like *Lecanoria tartarea* and *Lichen Roccella tinctoria L.* The dried lichens were extracted with potash solutions in the presence of air. These seaweeds were quite common on the rocks of the coasts of the Eastern Mediterranean. The Hebrew name for Archil, *pukh*, became a synonym for Egyptian, because the region was famous for the production of Archil. The dyestuff could also be used to colour the face. In later periods Archil / Orchil was referred to as 'the poor person's purple' (Laning 1997 unpaged)
(Hebrew: *phukh*; Greek: *phukos = rhizion*; Latin: *fucus alga maris / Oricella*).

Plant-based red dyes
Acacia Nilotica Del. * and *Acacia Arabica* are thorny trees, the wood of which was used to dye leather red. Seed pods of *Acacia Nilotica Del*. were used in dyeing textiles blue (see *Sunt)*.
(Hebrew*: Sita, Shittim);* Greek: *akantha*; Latin: *acanthus.*

*Alkanet** is produced from the roots of *Alkanna tinctoria* or *Anchusa tinctoria L.* Its colouring matter is dioxymethyl-anthrachinone, and it was used to dye wool. Alkanet is also called *False Alkanna* (see Henna).
(Hebrew: *alkanet hazawaim*; Greek: *calyx, porphyries, achousa*; Latin: *anchusa*).

*Henna** (Alkanna) is made from the roots of *Lawsonia inermis L.* or *Lawsonia alba,* cultivated in Palestine, Syria and Egypt.
Henna or *True Alkanna* was a popular dye, which together with *asafoetida*[41] was used to stain the hands, feet and other parts of the body. Henna was not used for tinting fabrics according to Dalman (1937:73), but Barber (1991:232) supposes that some of the 12th dynastic textiles from Egypt were dyed with Henna, which creates orangey-brown to pinkish colours.
(Hebrew: *kopher*; Greek: *kupros*; Latin: *cypros*).

*Madder** (*alizarin*) comes from the root of *Rubia tinctorum L.* (dyer's madder), known in antiquity as *the roots*. This dye – derived from plant roots – is the cheaper red dye.
Madder is a herbaceous perennial plant, with a succulent stem giving numerous fibrous roots. All parts of the madder plant contain the dye, but the roots have the largest concentration. When the plants are 18-28 months old the roots are harvested, in autumn, after the leaves have fallen. For extraction, the roots are dried, beaten to remove the dirt and the outer skin, and finally pulverized. Then the roots are boiled in a weak acid to dissolve the dye, and fermented to hydrolyze the glycosides to anthraquinone. The roots contain the dye in the form of glycosides in a red layer between the outer rind and the core of woody particles. The actual dye has to be freed by moistening the glycoside so that it splits into sugar and *alizarin*, the actual dye which colours the fibres. Extracting the dye therefore involves a rather complicated treatment processes. The extracted dye is made into a pigment by dissolving it in a hot aluminum potassium sulphate solution, and then the pigment is precipitated with soda or borax. Madder was a cheap substitute

[41] *Ferula assafoetida* is a herbaceous plant of the family Umbelliferae, also called Apiceae. It grows to 2 meters high, with a circular mass of 30–40 cm leaves. Flowering stems are 2.5–3 meters high and 10 cm thick and hollow, the cortex containing the resinous gum. Flowers are pale greenish yellow; the fruits are oval, reddish brown and have a milky juice. Roots are thick, massive and pulpy. They yield a resin similar to that of the stems.

for Kermes and probably the most common red dye in the Near East (Sheffer and Tidhar 1991:8). Unlike indigo and other dyes, madder needs a mordant before it will dye a fabric, which makes the process more difficult and variable. The pigments were commonly reused, giving a weaker colour such as salmon or pink, or they could be used with other dyes to give a range of colours; it was also used with iron alums to create reds and browns. Madder has been identified as the dyestuff used in the wool fragment from Kuntillet Ajrud (Sheffer and Tidhar 1991:8)
(Hebrew: *gua*; Greek: *erythrodanon*; Latin: *Rubia, varancia*)

Safflower (*Carthamus tinctoria L* and *Cathamus tinctoria var. inermis L.).*
Safflower is a highly branched herbaceous thistle-like annual with small globular flower heads. The flowers are picked by hand and pressed into cakes. The cakes are then thoroughly dried. The plant contains two colouring substances: one is safflower yellow, which is very weak, soluble and not of much value as a dye, and the other is carthamic acid, which is red and soluble. The flowers are pounded and then steeped in water until the water turns red. Then some alkaline substance like fuller's earth or potash is added to dissolve the red dye. Different shades ranging from red to yellow can be attained, but the colour is not very permanent. The word for safflower has been identified in Egyptian and in Linear B (Barber 1991:232). The use of Safflower as a dye is known from the Mishna.
(Hebrew: *kosa*; Greek: *knekos myrikè*).

Blue and purple
The availability of good blue dyes was limited. Different plant juices were used for blue dye, but the most famous blue dye produced in the Eastern Mediterranean was Tyrian purple or *Royal blue*.

Purple and blue dye derived from shellfish (Murex) [42]
Different kinds of molluscs were commonly used as a source of blue dye.

*Murex**. *(Murex trunculus, Murex brandaris, Buccinum lapillus, Helix ianthina)*.[43] The colouring matter produced by the whelk is a secretion contained in a little vein or cyst of the shellfish. When broken or squeezed by hand, this cyst produces a white fluid. The fluid soon turns yellow under the influence of air and is then transformed into the purple dye through further oxidation. Cloth dipped into the fluid will first turn yellow, and when exposed to strong sunlight and air the colour will develop into purple or scarlet. The juice extracted from *Murex brandaris* changes photochemically into a deep blue violet, while that of *Murex trunculus* and *Purpurea haemostoma* gives a scarlet red colour.

Purple production is usually associated with the Phoenicians, especially with Tyre and Sidon, although the earliest archaeological evidence is from Crete, dated to 1800-1600 BC (Cardon 2007:571). In the Levant the production of shellfish purple was established by 1500 BC, as is known from the documents from Ugarit (Lambert 1997:87-88). At Tell Mishrifeh (Qatna) remains of purple dyed textile has been found dated to 1400 BC (personal communication P. Pfalzner 2012). The heaps of crushed mollusc shells in Syria, Lebanon, Israel, Crete, Spain, North Africa and Italy testify to the scale of the industry in antiquity (Gleba 2008:80-81; Barber 1991:228-229). Small quantities of shells are not sufficient to prove the existence of a purple dye industry (Karmon and Spanier 1987:149). Large deposits of holed or crushed shells have been found at Tyre, Sidon and Ugarit (Rash Shamra).[44] According to Jensen, *Murex brandaris* shells are mostly found at Tyre, while *Murex trunculus* shells are more commonly found at Sidon. *Helix ianthina*

[42] The production of purple has been studied by, *inter alia*, Forbes 1956:113, notes 56 and 57; Jidejian 1996:279-304; Uriel 2010.
[43] Other purple-bearing mollusks are *Thais haemastoma* (*Purpura haemastoma*), *Buccinum lapillus* (Forbes, 1956:109, Jensen 1963:105.).
[44] For a brief history of royal purple and relevant documentation concerning the analysis of the Sarepta finds, see Jensen (1963:104-118; McGovern and Michel 1984). Phoenician purple dye is described in Uriel (2010) and Tyrian purple has been studied by Jidejian (1996).

was found near Beirut and also around Tyre, while *Purpura lapillus* was found along the coast from Mount Carmel north to Ugarit (Rash Shamra). Mixed with the crushed shells are numerous cardium (cockle) shells that were used as the principal bait to catch Murex (Jidejian 1996:279). Wool destined to be dyed with real purple was pre-treated with ox gall to clean the cloth and ground the colour. Then the wool was kept for five hours in the vat. In some cases the vats used for dyeing have been found, as in Tell Keisan where large clay containers were used as dying vats (Karmon and Spanier 1987; 1988). At Tel Shikmona, shells and sherds with residues of purple dye have been excavated. Large amounts of dye-producing shells were also found in Tel Keisan and Tel Akko. At Tel Dor thick layers of shells were registered together with pits showing purple coloured layers of sediment (Shalev and Nitschke 2011). A *Murex brandaris* whelk shell has been excavated at Tell Deir Alla (Vogelsang-Eastwood 1989:60).

Experiments and analysis
In 1961 a team from the American University of Beirut conducted the first experiments on purple dye, using shellfish. The research and experiments by J. Doumet in 1980 showed that only a certain species of *Murex trunculus* had the necessary enzyme for the production of the purple dye. E. Coe and R. Jannun of the Department of Biochemistry (American University of Beirut) succeeded in isolating the enzyme that produces the purple colour (Jidejian 1996:294-295). In 2005 Belgiorno, Lentini and Scala conducted purple analyses on Cyprus. Biometric comparisons of the shell perforations, made in correspondence with the purple glands, showed an axial difference of only 0.1 mm. Judging by the uniformity of hole, it is presumed that holes in the shellfish were made with a special instrument. The sediments analyzed through micro-analytical techniques contained significant quantities of bromine, which is the typical component of Tyrian purple. Bromine pigment can assume various tonalities of blue colour. Of the different shades of purple, 'Royal' or 'Tyrian blue' was the most praised for its beauty and lightfast qualities. True Tyrian Blue and all kinds of Purples were extremely expensive.[45] Because purple dye was so expensive it was of course imitated and many recipes for substitutes were known. True Tyrian blue was a vat dye, but most of the substitutes were mordant dyes (see below) and needed a mordant such as filtered limewater or iron acetate (iron oxide dissolved in vinegar).
Sidon and Tyre are mentioned in the Hebrew Bible (Ezek. 27:7, 24; Est.1:6) as suppliers of *argaman* (purple). The Hebrew word t*ekhelet,* which was probably a shade of violet or light blue, (Num.15:38; Ex.28:33; Ex.39:5) has been translated blue in the King James Version ansd in the American and British Revised Versions.
(Hebrew: argaman + tekhelet; Greek:porphyra + hyakinthos; Latin: Purpura).

Plant-based blue dyes
The source for colourfast blue dyes derived from plants is often called *Indigo,* although the precise plant or plants from which the dye came is still uncertain. The sources of the indigo dye reported from the Southern Levant (Sheffer 1976:85 note 7) and the blue dyes mentioned in Egyptian texts are subject to the same question. The indigo plant was preferred over the woad plant wherever indigo was known, since the indigo plant contains ten times the concentration of indigo colourant as woad (Barber 1991:235).

*Indigo** (*Indigo argentea, Indigofera coerula* and *Indigofera tinctoria*).
A variety of plants provided indigo but most natural indigo was obtained from plants in the genus *Indigofera*. Indigo or *anil* was extracted from the leaves of the plants, and this process was important economically in a period when blue dyes were rare.
An experiment with indigo, performed on Cyprus by Belgiorno, Lentini and Scala in 2005, confirmed that *Indigofera* is widespread in all the southern Mediterranean countries, including

[45] According to Forbes (1956:119), in the Roman period the price was about $7000 for 500 grams, but he does not mention the original price.

ornamental species such as: *Indigofera tinctoria*, *argentea, intricata, spinosa* and *semitrijuga*.[46] The leaves of the *Indigofera* (either natural or dried) were soaked in wooden basins containing *Alga focus* (a large brownish seaweed), water and limestone. The chemical reaction of the components produced a colouring matrix that precipitated into blue flakes. This matrix created semitransparent, extremely fine, granulations of intense blue colour. The results are comparable to the colour of Indian Blue made in the classical way.[47]
At Iron Age Kuntillet Ajrud, some indigo-dyed linen textile fragments have been found (Sheffer and Tidhar 1991:8). Burckhardt (1822:392) notes that indigo was a very common product of the Ghor (the Jordan valley), and that it was sold to merchants in Jerusalem and Hebron. Tristram (1865:337) mentions seeing silos full of indigo in the Ghor. Real indigo *indigofera argentea* (cultivated and wild) was found near Tiberias and east of the Dead Sea in 1920 (Dalman 1937:73).
(Hebrew: *nil* + *indaco*; *alaila* Greek: *indikon chroma*; Latin: *caeruleum indicum, indicum*)

*Sunt** (*Acacia nilotica Del.*). The seedpods of the Acacia were used to make a blue dye, which seems to have been of a poor quality.
(Hebrew: *sitta*; Greek: *akantha*; Latin: *acanthus*).

Woad *(*Isatis Tinctoria L.*). Woad is a temperate herbaceous biennial, bearing yellow flowers in the second year. As soon as the leaves turned yellowish they were cut and ground to a smooth paste. This paste was placed in heaps, pressed close and smoothed and left for about two weeks; then the crusted heaps were opened up and mixed. The semi-dry paste was formed into oval balls and kept under pressure while drying. Before the dye was ready for use, the balls were reduced to powder, moistened and allowed to ferment for about nine weeks. This process causes a decomposition of the colourless compound *indican* into fructose and indoxyl, which is then oxidized by exposure to air into *indigo*. Immediately after fermentation, woad was used in the dyer's vat together with urine, the ammonia of which kept the vat alkaline. The dye then gave a good and permanent blue. The dye derived from woad has been identified on some linen textile fragments from Iron Age Kuntillet Ajrud (Sheffer and Tidhar 1991:8).
(Hebrew: *isatis*; Aramaic: *izlim*; Greek: *isatis*; Latin: *gastum vitrum*).

Yellow
Yellows could be obtained easily from a wide variety of plants. Quite a number of yellow dyes were known, but the most famous were Pomegranate, Saffron and Curcuma. Weld, which is known as an important resource for fast yellow dyes, has no pre-Iron Age evidence (Forbes 1956:124; Barber 1991:233.

*Pomegranate** (*Punica granatum L.).* Pomegranate rind was used to make a yellow colour. Pomegranate has been found in Iron Age contexts: remains were discovered in storage pits at Tell Qiri and Tell Halif (Borowski 2002:117) and at Tell Deir Alla (Van der Kooij and Ibrahim 1989:34). From these finds, however,there is no evidence that the fruits were used for dyeing.
(Hebrew: *rimmon*; Greek: *rhox*; Latin: *granatum*).

*Saffron** is made of the dried stigmas and tops of the styles of Saffron (*Crocus sativus L)* and Meadow Saffron *(Colchium autumnale*). Saffron gives a strong yellow colour. It was grown in Syria and Egypt but not in Palestine.
(Saffron: Hebrew *Karkom*; Greek: *Crocos*; Latin: *crocus*).

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[46] Till recently it was thought that indigo only appeared in the Levant in the Hellenistic period, as stated by Forbes (1956:110).
[47] True Indian blue was a native of India. The colouring agent of indigo blue was made from the whole plant; after harvesting the plant grew again, so several harvests were possible. Indigo was produced as follows: a vat with water and leaves was put outside in the sun and stirred till it became a paste. The paste was left to ferment for 1-3 days. The indoxyl and glucose split during this process. After fermentation the vat was left standing to give the liquid a chance to clear. The transparent scum was separated and mixed (beaten) in the beating vat until the indoxil oxidized into indigotine.

(Meadow saffron: Hebrew: *Karkom*; Greek: *ephemeron*; Latin: *ephemerum*).

Turmeric Curcuma longa L*. The dye is made of the roots that contain curcumin. It grew in Arabia, India and Mesopotamia. It is often called *krokos* or *Indian Saffron*.
(Hebrew: *Karkom*; Greek: *krokos*; Latin: *crocum*).

Weld * (*Reseda luteola L)*. Weld (*wau, guede*) or dyer's rocket is a herbaceous plant (annual, biennial or perennial). The crop is harvested by pulling up the entire plants when still blossoming. They are left to dry thoroughly for a week or ten days and tied up in bundles. Every part of the plant except the roots can be used for dying, although most of the dye is found in the seed. Luteolin is a flavone, which is a natural yellow with a phenyl-benzopyrone structure. It is present in the plant as glycoside or tannic esters. Following extraction, the dye can be utilized either fresh or desiccated. Like madder, weld needs a mordant before it will dye a fabric.
(Hebrew: *rakhapha*; Aramaic*: bakkam*; Greek: *ochra + crocos*; Latin: *lutheum*).

Brown and black
Carbon black, bitumen and charcoal are organic dyes[48] not used in the textile industry.
In textile production, different shades of black to light-brown colours were derived from various plants and fruits.

*Myrtle** (*Myrtus communis L*.). The myrtle is a shrub with evergreen leaves and small white flowers, which are produced in the middle of the summer. The fruit is a small, black berry resembling a blueberry that is edible but seldom eaten. The entire plant contains tannins, flavonoids and a volatile oil. A black hair dye was made from the myrtle, which became popular throughout the Near East.
(Hebrew: *hadas*; Greek: *mursine*; Latin: *mursine*).

Oak Gall (*Xanthium strumarium L)*. Gall-black dye was derived from wasp galls growing on Mediterranean Oak trees (*Querqus)*. Gall-black was mordanted with alum and used to dye wool black. The Mediterranean oak (Querqus)* has been reported from Iron Age finds. Oak gall used in dyeing is not attested in the Iron Age but is known from the Mishna to have been used in the dyeing process.
(Hebrew: *'éphes*; Greek: *kekides*; Latin: *gallae*).

*Pomegranate** (*Punica granatum L*). Pomegranate liquor combined with ferrous sulphate gives a black dye. Pomegranate rinds were also used for the tanning of leather. Pomegranate remains have been found at Tell Deir Alla (Van der Kooij and Ibrahim 1989:34), Tell Qiri and Tell Halif (Borowski 2002:117), but it is unknown whether these finds were used in the dyeing process.
(Hebrew: *rimmon*; Greek: *rhox*; Latin: *granatum*).

*Walnut * (Juglon, Juglans regia L*.). Juglon was the name of a dye made from the green rinds of the nuts of the Persian or common walnut, the extract of which formed a nut-brown dye that could give wool a brown to black colour. There are no remains of walnuts reported from the Iron Age (Borowski 2002:133).
(Hebrew: *egoz, aguza*; Greek: *karua*; Latin: *nuces iuglandes*).

[48] *Bitumen* is asphalt; a sticky semi solid, it is found in a few natural deposits in the regions around the Dead Sea. (Hebrew: *hemar*; Greek *asphaltos;* Latin: *bitumen*). *Carbon black* is soot prepared from bones or wood. (Hebrew: *heret*; Greek*: aithale*). *Charcoal*. (Hebrew: *peham*; Greek: *anthrax*; Latin: *carbo*).

Chapter 3 Looms in antiquity

Weaving is the process of interlacing two or more sets of thread, according to a pre-defined system, to produce a cloth (Vogelsang-Eastwood 1993:40). Weaving differs from plaiting, basketry and matting, in that mats and baskets are made of short stiff materials with a body of their own, whilst weaving is done with flexible string and thus requires a temporary frame or brace to hold the yarn and to provide some tension while interlacing the flexible string. The brace, the structure used to apply the tension required for the warp threads, is called a loom. Looms can be very simple; in the simplest form they hold tight one set of threads, the warp threads in order to pass the weft into the warp.[49] The weft passes over and under the warp threads, thus forming the woven cloth. A basic loom has a back beam to which the warp threads are tied. In this chapter I will introduce different kinds of weaving and the looms used in antiquity. This will demonstrate how an innovation in weaving, a flexible hanging kind of loom, originally from central Europe, spread via Italy, Greece and Anatolia into the Levant. The loom was meant to make patterned weft, and some of the tools used in the production will be discussed.

3.1 Different types of looms

Looms may vary considerably in their design and functioning. The main classification of looms is based on the position of the warp threads whilst weaving. On horizontal looms the warp threads (and the woven cloth) are in a horizontal position, while on vertical looms, also called standing or hanging looms, they are vertical. In all the different looms, weaving was first conducted with the fingers and later with the help of a shed rod or shed bar; then with a rod heddle and shed rod, and finally by multiple heddles (Forbes 1956:202). A shed rod or a set of heddles separates the odd and even threads, and when manipulated, opens up an area called the shed.

Horizontal looms

There are several types of horizontal looms: the band loom or back-strap loom, the ground loom and tablet weaving.

a) The band loom or back-strap loom (fig. 3.1)

The oldest form of weaving was done on this type of loom. Tension is achieved by tying one end of the warp threads to a fixed point, such as a tree or pole, whilst the other end of the threads is attached to the person weaving. The tension on the warp threads can be adjusted simply by leaning back. Because the warp must be allowed to spread out, as the weft is introduced to the full width of the cloth, ten centimeters is about as wide as you can spread the warp when it is tied to a single point without serious tension problems because of the angle of the threads. By tying the warp threads to a rod, the warp beam can partly solve the width problem, but despite the use of a warp beam, this loom can only be used to produce narrow bands of cloth. Other names for the band loom are body-tensioned loom or waist loom.

[49] The warp is also called the *chain* or the *ends.* And the weft is also known as the woof, the abb, shot shute, shoot, picks, filling and tam (Hodges 1970:133).

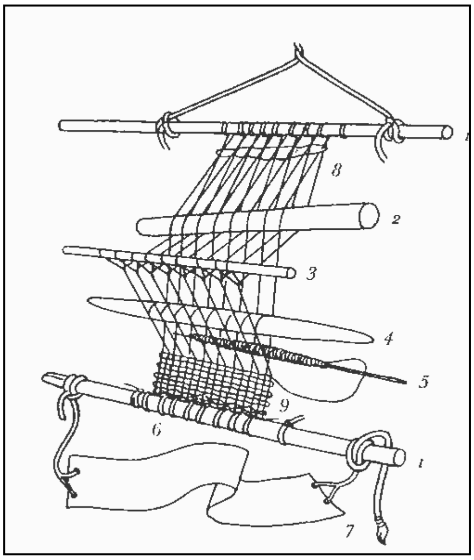


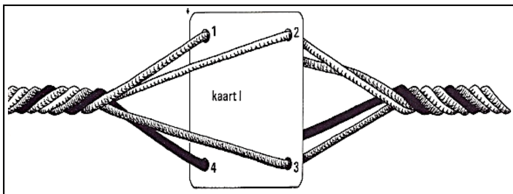
Fig. 3.1. Back-strap loom. The girdle (7) can be fastened to the body of the weaver; the other end can be attached to an immobile object such as a pole or a tree.

b) The ground loom (fig. 3.2)

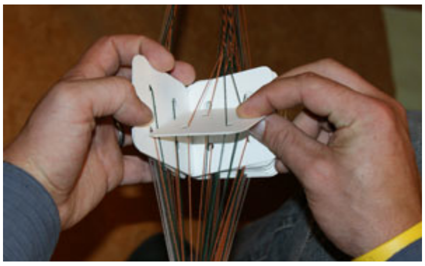
The horizontal ground loom solves some of the practical problems of the back-strap loom. The warp threads of the ground loom are attached at both ends to a rod and the rods are pegged into the ground. The resulting loom is called an horizontal ground loom; the warp threads are not attached to the weaver, it is stable and it can be set up to accommodate any size of cloth, the only restraint being the width of the human body. If the cloth is wider than the weaver can reach, she/he must change position with every row of the weft, which is impractical. Therefore, the weaver would generally choose a width that he or she could reach. The Egyptians solved this problem by having two people working at the loom, one on each side (Barber 1991:81,84 fig. 3.5). It is necessary to divide the warp threads to be able to weave the leading thread over and under the warp threads; a heddle could be used to form an opening between the threads (the shed). The heddle bar is a stick with deep slots on one side and a flat underside. The slots are held uppermost and the flat side rests on top of the warp. In the Middle East the heddle is often placed on sizable stones or inverted pots on either side of the loom (Barber 1991:87). The shed rod is flat and used to open the weft of the loom to form the shed, the threads are manipulated by a wide and flat piece of wood; it can be turned up on edge to form an open shed and it can lie flat and unobtrusive in the shed when the counter-shed is open (Barber 1991:86). The horizontal ground loom has been used in the Levant from the Neolithic to the present day.

Fig. 3.2. Woman weaving tent cloth on a ground loom in Beida (Jordan), spring 2001.

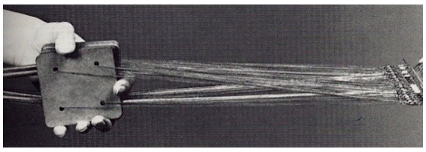
c) Tablet weaving (fig. 3.3)
There is a second solution to the problem of mechanically dividing the shed on a band loom (Barber 1991:118): with the help of implements such as tablets or cards. It is called tablet weaving or card weaving. *Brettchenweberei*, the German word for this type of weaving, is particularly illustrative because the bands are woven with the help of a collection of tablets (*Brettchen*), usually made from wood, horn, leather or bone. The shape and the size of the tablets can vary. The most common type of tablet in folk tablet weaving is square, and measures about 6-8 cm on each side (Hald 1980:225). Nowadays, tablets are in the range of 5-9 cm on each side. Lise Raeder Knudsen studied Iron Age tablets from Denmark, and found their size varied from 3.0x3.0 to 4.8x5.3 cm.

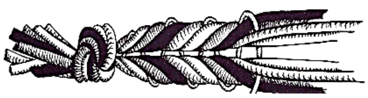


The tablets



Rotating the tablets and opening the shed





Result

Fig. 3.3. Tablet weaving using rectangular tablets (after Gerritsen-Veen1983:147).

Most tablets are square, with rounded corners, and with a hole in each corner through which the threads of the warp are threaded. But tablets with other shapes were also used. From Scotland, pyramidal or hexagonal tablets are known (fig. 3.4); Hodges (1970:137) mentions small oval disc-shaped tablets, with a hole or a set of holes at each end. A minimum of two holes is needed in a tablet to form the weft.
The tablets actually constitute a small loom. Each warp thread is led through a hole in the tablet. The neighbouring warp threads go through the cards or tablets to form a pack held vertically. By rotating the tablets the warp threads are forced up or down. The clockwise rotation of the tablets or part of the tablets creates a pattern in the warp threads. Tablet weaving is a warp-faced weave; the fabric shows a corded effect. Numerous patterns can be woven with little equipment, but the width of the cloth is limited to narrow bands. The woven bands were used as belts or as decorations sewn on cloth; they also served as starting borders on the vertical loom (see below).
When the weaving is to take place, the tablets are placed edge to edge with the mounted warp; as the threads are twisted they divide into two layers with a gap in between. The weft thread is then passed through this gap *(*shed). When 4 threads are used there are four shed openings through which to pass the weft. The tablets are turned forwards and backwards forming patterns in the

weft. When the set of tablets are turned in the same direction at once, the four threads twist around each other forming warp cords that hide the weft entirely. Margrethe Hald calls this sort of weaving 4-ply tablet weaving. When only 3 or 2 holes are threaded the name is 3-ply tablet weaving or 2-ply tablet weaving (Hald 1980:226). A slightly different use of the tablets is possible because the tablets need not necessarily be turned together in the same direction, different cards can be turned separately forming an interplay in the warp that produces a fascinating pattern (in the warp-faced weft the weft forms the pattern)
It is important to realize that in tablet weaving the sets of cards are used as a small loom. Such a set consists of about 10-50 (or even more) very thin and smoothed tablets. The number of tablets depends on the width of the band to be woven; more tablets create a wider band.

Tablet weaving has been recorded from the Early Iron Age in Denmark and Norway. In Spain, early tablets, measuring 3x3 cm, have been recorded from 400-375 BC. In Egypt, tablets measuring about 4x4 cm have been found which date to the 5th century AD. Weaving tablets are known from Roman sites in Germany and England, both triangular and square ones, measuring between 3x4 and 4x4 cm. Some of these tablets have engraved patterns of lines and circles on one side (Raeder Knudsen 2010:151). This can also be seen on the medieval tablets from Scotland, on display in the Museum of Edinburgh.
Tablet woven material can be distinguished from other kinds of woven material because of the curious corded effect. However, there is a kind of tablet weaving that does not show the corded effect, in which case it is very difficult to recognize tablet weaving (Hald 1980:226). Tablet weaving was carried out in conjunction with ordinary weaving (Hald 1980:272). Tablet-woven borders were used as starting borders, the basis of the warping arrangement. Raeder Knudsen (Reader Knudsen 2010:156) performed a weaving experiment with tiny wooden Early Iron Age tablets measuring only 3x3 cm. She concluded that these tablets are very useful for making integrated tablet-woven starting borders for the vertical loom. (Further information below in the section on the warp-weighted loom.)

Fig. 3.4. Medieval tablets from Scotland.

Vertical looms
The vertical loom is a hanging or standing loom used to produce large pieces of cloth.
There are several different types of vertical loom.

a) The simple vertical loom (fig. 3.5)
This is a variation of the horizontal loom: it consists of a fixed set of warp threads stretched between the wooden frame of the loom. The length of the cloth is limited to the length of the fixed

construction of the loom, which means that there is no possibility to elongate the warp. The simple vertical loom was the main type of vertical loom used in the Levant until the introduction of the warp-weighted loom, and was possibly used later alongside the warp-weighted loom. The simple vertical loom is well documented from Egypt (fig. 3.5).

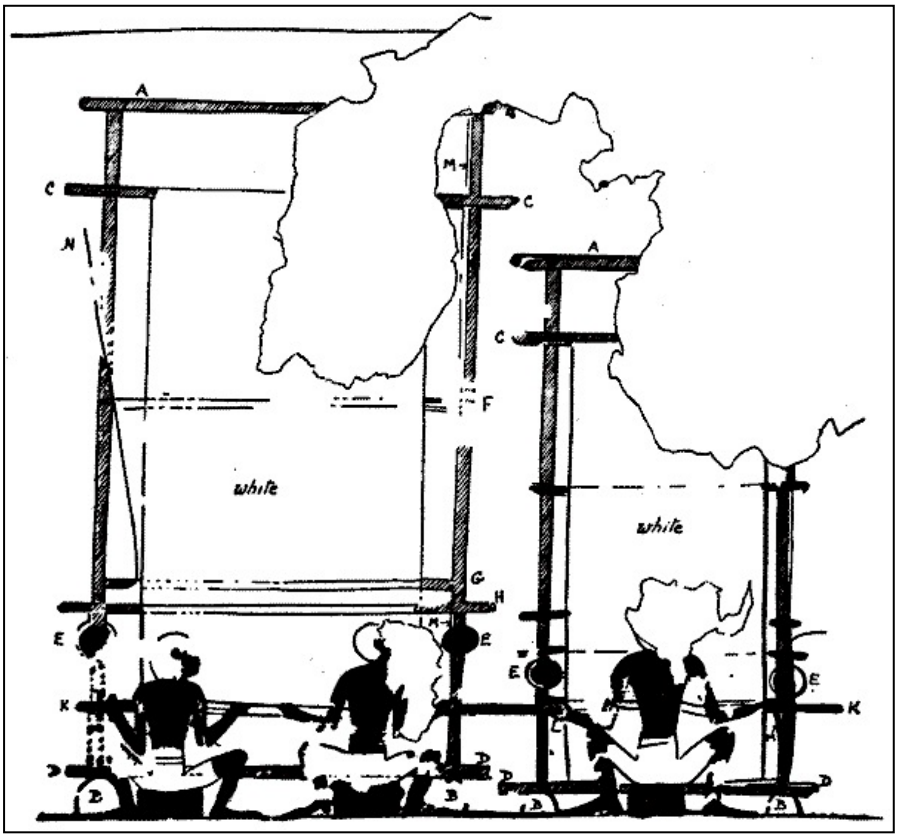


Fig. 3.5. Upright or vertical looms from the Tomb of Djehutynefer TT104 at Thebes, 18th Dynasty, c. 1425 BC. From a drawing by N. de G. Davies (after Ling Roth 1913:10 fig. 9).

b) The warp-weighted loom (fig. 3.6 left and figs. 3.13- 3.15)

The warp-weighted loom consists of two vertical side beams, linked across the top by a cloth beam that could be revolved using holes in the uprights. A bracket with a forked end was pegged into each upright at about chest height. The forks supported the ends of a movable heddle. Lower down, a shed rod was secured in position across the gap between the uprights (Vogelsang-Eastwood 1993:55 based on Wild 1988:31-36).

The uprights did not stand absolutely vertical but were made to lean at an angle against a wall or a roof beam (Brittnell 1977:238-239). The warp weights were made of stone, clay or pottery, often pierced with holes and each tied to a bundle of warp threads. The perforated loom weights were not directly tied to the warp threads themselves, a looped cord was tied through the hole of the loom weights in between the bunch of warp threads and the loom weight. The weaver stood in front of the loom and the weft was beaten upwards.

A separately woven starting border was attached to the upper beam. The starting border served to keep the warp evenly spaced on the loom and prevented the drawing in and crowding of the warps (Crowfoot 1955:22; Bellinger 1962:11). According to Hoffmann, the starting borders can be divided into two groups, either woven or corded starting borders (1974:154). Woven starting borders are made from narrow separately woven bands produced by the card weave technique. Corded starting borders are made with a separately produced cord, interlaced with the warp threads at the beginning of the weft. Both kinds of starting borders are interwoven with the warp threads at the top of the warp-weighted loom. It was possible to extend the cloth on the warp-weighted loom by rolling up the finished cloth on the upper beam. The flexible hanging warp threads made pattern weaving easier, and the tension on the warp could be adjusted (within limits) by changing the weight of the loom weights or the number of loom weights used for a bunch of warp threads. The advantages of the warp-weighted loom are discussed in more detail in 3.3 below (figs. 3.13-3.15).

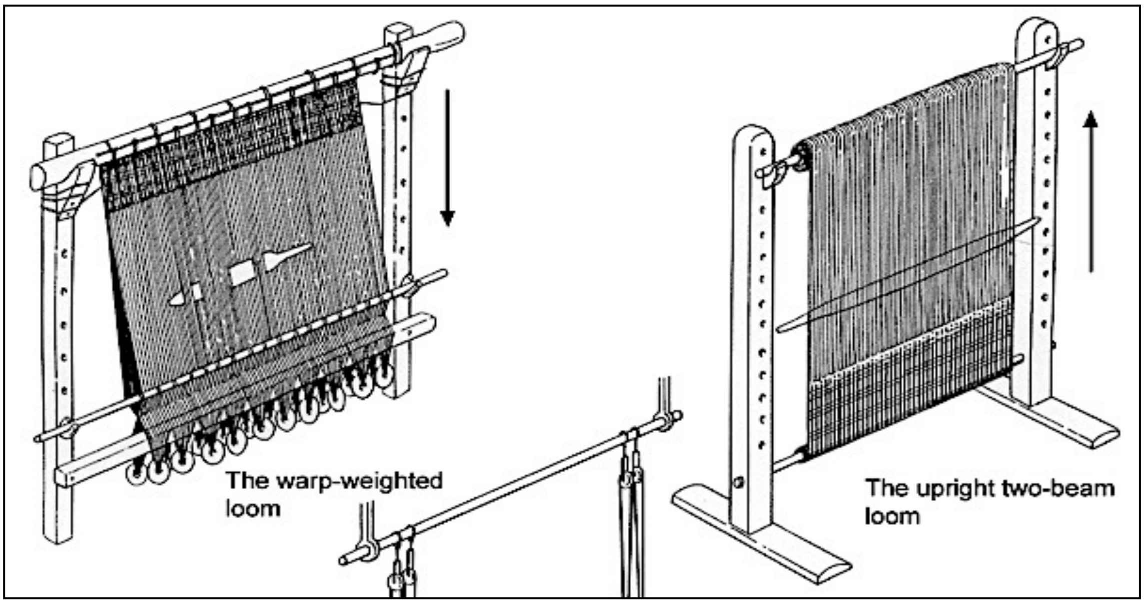


Fig. 3.6. Vertical looms (after drawing in Winchester Museum).

c) The upright two-beam loom) (fig. 3.6. right)
A third type of vertical loom is similar to the warp-weighted loom, but here a horizontal beam linking the uprights replaces the weights. It differs from the simple vertical loom in the possibility to elongate the warp threads. In this construction two horizontal beams are used to construct the loom: the upper beam keeps the warp threads extended and the lower beam is used to roll on the cloth length. Two bars were used as shed and heddle rods. The weaver stands in front of the loom, weaving from bottom to top, and the weft is beaten with a downward motion. The lower cloth beam was fixed into position in a variety of ways; it could be placed in a slight hollow in the ground or rest in grooves cut out of heavy blocks of some kind (Vogelsang-Eastwood 2000:278). Suitable heavy limestone blocks (*socket-blocks/beam-supports*) have been found in the Workman's Village at Amarna (Kemp and Vogelsang-Eastwood 2001:373-391). Vogelsang-Eastwood presents a very interesting reconstruction of the vertical loom showing in detail the functioning of this loom (Kemp and Vogelsang-Eastwood 2001:405-426). She also points to the possibility that weights were used on the two-beam vertical loom to control the tension on the warp beam (Kemp and Vogelsang-Eastwood 2001:393-394). In fact the two-beam loom is a Near Eastern amalgamation of the two-beam tensioning system of the horizontal ground loom and the vertical warp-weighted loom.[50]
This new vertical two-beam loom on which one wove with a downward motion while sitting, rather than upwards while standing, spread all over the Ancient Near East (Barber 1991:124-125). It seems to have originated in Syria and was extensively used in Egypt (Cecchini 2000:213), where it was in use from the New Kingdom onwards (Barber 1991:90, Vogelsang-Eastwood 1993:56; 2000:278; Allgrove-McDowell 2003:34). The warp-weighted loom continued to be used in the lands north of the Mediterranean until the turn of the era when the Romans began to adopt the two-beam loom from their subjects in the Near East. The Romans spread the two-beam loom

[50] In Egypt the introduction of the fixed vertical loom has been ascribed to the Hyksos. Vogelsang-Eastwood is right when she states that this attribution should be treated with caution, given our lack of knowledge of the range of looms used by the Hyksos themselves (2000:278). Barber suggests a Levantine origin of this kind of loom (Barber 1991:124-125), while Cecchini (2000:213) points to a Syrian origin. In general the Near East can be seen as the cradle of the upright two-beam loom.

northwestwards across Europe. But the warp-weighted loom continued to be used in parts of Europe into medieval times and in Scandinavia until the middle of the 20th century (Hoffmann 1974).

3.2 Artefacts associated with weaving

A number of factors contributed to the production of a regular and tight weave. Among these are loom weights, combs, beaters, spatulas and shuttles.

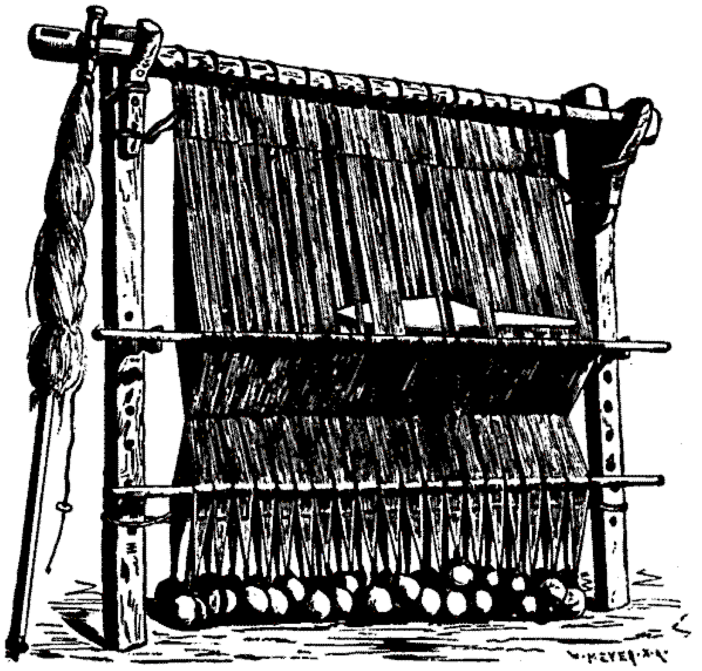


Fig. 3.7 Reconstruction of a Scandinavian warp-weighted loom using two rows of loom weights (Meyer after Ling Roth 1913: fig. 32).

Loom weights

Weights used to stretch the warp threads are called loom weights. Such weights were used on the warp-weighted loom. They could be made from different materials, such as stone, ceramic, unfired clay and lead. Their shape varied over time. Loom weights may survive even when the wood of the loom decays, which enables the reconstruction of the warp-weighted loom in archaeological contexts – see further Chapters 4 and 5.

Combs

Combs were used to comb the wool before spinning. It is also possible to use a comb to beat the weft into the warp on different types of looms. Wool combs and weaving combs are made of wood, bone or horn. Weaving combs are very seldom found. It is not easy to differentiate between combs in the archaeological record; only when such a comb is found together with artefacts related to weaving can it be determined as such. In Egypt and Europe weavers' combs were *c*. 20 cm long, 10 cm wide and 4 cm thick, with teeth cut into one end (fig. 2.7).

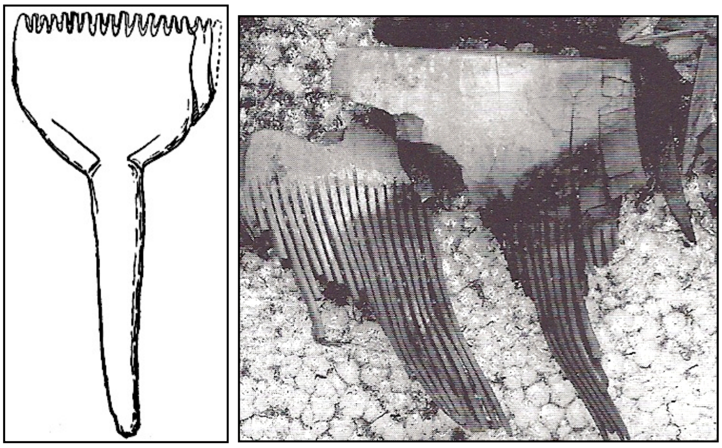


Fig 3.8. Left: weaving comb,19.5x9.8x4.2 cm, Manchester Museum (Ling Roth 1913 fig. 1). Right: fine wooden weaving comb from Gordion (Burke 2010:132 fig. 71, courtesy of B.Burke).

Wooden combs have been found at a number of sites in Egypt, according to Vogelsang-Eastwood, and were probably used as weavers' combs (2000:277). In Italy, combs have been found which may have been used in wool combing: a horn comb from Fiave-Carera (Middle Bronze Period) and pairs of combs made of sheet bronze in a 3rd-century tomb in Este (Gleba 2008:99 fig. 73), In Germany and the Netherlands, such combs are known from various places and periods (Barber 1991:184). At Gordion, a long-toothed wooden weaving comb (6 cm wide) was found in the anteroom of Terrace building 2. The comb was found containing unwoven warp threads on one side and woven textile on the other. It was found together with loom weights and other tools (Burke 2010:131-132, fig. 71). A comb is recorded from Iron Age Hama, found together with two complete spindles and three spindle whorls (Cecchini 2000:225). It is not yet clear whether combs were used less in the Levant or if they have not been found because they were made of wood.

Beaters

Beaters were used to reduce the space between the threads of the weft, to tighten the weft and to beat the weft into the warp. Differently shaped artefacts were used as beaters. The sword beater is a smooth stick, as long as the width of the loom. It could beat up the entire row after it had been passed through the shed. Due to constant contact with the warp the bar or stick would become worn and shiny along the length of the stick. These artefacts are known from Egypt where their shape and size could vary considerably (Vogelsang-Eastwood 2000:277). In the Levant these (wooden) artefacts have not been found owing to climatic conditions, or they have not been recognized as such. The much smaller *pin beater* is a straight or curved artefact that could be made from bone, ivory, wood or iron. Even a complete gazelle horn could serve for this purpose (Dalman 1937:96). The pin beater is used to push the weft between pairs of warp threads. Hoffmann observed the use of pin beaters in Norway; she states that pin beaters are used in fairly close-set fabrics (1974:329-321). Crowfoot associates pin beaters in the form of sticks and gazelle horns with clinging woollen threads (Roth and Crowfoot 1921:100). Pin beaters have been reported from Tell Deir Alla phase IX (Van der Kooij and Ibrahim 1989:99, figs.83 and 167). Curved objects, possibly used as beaters, are often reported from the Levant but are seldom associated with textile production.

Spatulas

Spatulas or *laminas* are thin, pointed tools made of bone, with an oblong and flat shape (fig. 3.8). They are between 10 and 12 cm in length, 1.5-2 cm wide and 0.1-0.2 cm thick, made of animal ribs, smoothed, with their points showing signs of wear (Hollander 2003). Most spatulas have one sharply pointed end, but sometimes both ends are sharpened (Cecchini 2000:223). Spatulas are sometimes called pin or sword beaters (Vogelsang-Eastwood 1989: 60, Van der Kooij and Ibrahim 1989: 99). The spatula can be distinguished from the pin beater by its shape.

In the southern Levant spatulas have been excavated in Megiddo (Lamon and Shipton 1939 pls. 95:39-62; 96:1-9), Tell Deir Alla (Vogelsang-Eastwood 1989:60; Van der Kooij and Ibrahim 1989:99, fig. 80, 81,82, 84; Hollander 2003), Tel Ira (Beit-Arieh 1999:451), Tell Ta'anach (Friend 1998:7), Tell Jawa (Daviau 2002:191-200, 261 figs. 2.154:1 and 2.154:2), Tell Abu al-Kharaz (Cristiani 2006) and Khirbet el-Mudayna (see this volume, chapter 8). In Syria bone spatulas have been recorded from several sites. They have, for instance, been reported from Tell Afis (Cecchini 2000:223-229, fig. 6), Tell Mishrifeh / Qatna (Garna and Besana 2006) and Tell Abou Danne and Oumm el-Marra (Doyen 1986).

The function of these objects has long been debated, for an overview see Cecchini 2000:223, note 63.[51] Friend suggested that spatulas from the Levant were used as pattern weaving tools, based on their similarity to traditional weaving tools (1998:7). In 1924 Johl (1924:56) suggested that three wooden examples from Berlin were *Zählnadeln für Musterweberei* (counting needles for pattern weaving) on a vertical loom. Spatulas were used to pick up some of the warp threads, enabling the weaver to make a pattern in the weft, and therefore they are sometimes called pattern sticks. Because the warp-weighted loom is very suitable for weaving patterns, spatulas are usually found in association with loom weights (Crowfoot 1941,1944,1945; Tufnell 1953:397; Hoffmann 1974:320), but spatulas can be used on other types of loom as well. Petrie suggested the spatulas were artefacts used in netting (Petrie 1917:53). In Egypt, spatulas have been reported from Amarna, Medinet el-Ghurab and Memphis, but no loom weights have been found here (Kemp and Vogelsang-Eastwood 2001:358). Research on the Amarna bone points has been conducted and published by Vogelsang-Eastwood. In Egypt, the use of spatulas is limited to the period of the New Kingdom (Kemp and Eastwood 2001:358-404). Kemp and Vogelsang-Eastwood studied signs of manufacture and use on the bone spatulas from Amarna; their conclusion is: '…the suggestion that spatulas were used in weaving is still a reasonable interim identification.' (2001:358-372). Two new studies reaffirm the use of the spatula as a weaving tool. Hollander studied the bone implements of Tell Deir Alla. In an experiment on modern bone tools, she showed that contact with wool and linen produces the same sheen on the bone as can be seen on the archaeological bone implements. She concluded that spatulas showing wear on the pointed ends were used to lift up warp threads, to weave patterns into the weft (Hollander 2003). Cristiani studied three bone spatulas (*shuttles*) from Tell Abu al-Kharaz, made of half ribs. These spatulas were compared with modern bone tools that were used during experimental work with wool. The comparison between the archaeological use/wear traces and experimentally produced traces suggest that the bone tools were used in contact with animal fibres (Cristiani 2006:401).

Increasing numbers of loom weights from different Iron Age sites in Syria and the Southern Levant are found together with spatulas. In the northern Levant, spatulas and loom weights have been found in association at sites such as Aleppo, Hama, Tell Abou Danne, Tell Nebi Mend and Tell Afis. For a discussion and overview see Cecchini 2000:223-229.
In the southern Levant, the combination of loom weights and spatulas has been recorded at Megiddo (Lamon and Shipton 1939, pls.95:39-62; 96:1-9), Tell Deir Alla (Vogelsang-Eastwood 1989; Hollander 2003), Tell Ta'anach (Friend 1998:7), Tell Jawa (Daviau 2002:191-200, 261 figs.2.154:1 and 2.154:2), Tel Beersheba (Yasur Landau, Ebeling and Mazow 2011:292-293), Khirbet al-Mudayna (see Chapter 8) and Tell er-Rumeith (see Chapter 9). It has been suggested that in the Levant spatulas are limited to the Iron Age, but the finds at Tell Abu al-Kharaz show that spatulas already appear in the Jordan Valley in the Early Bronze Age (Fischer 2008:355 fig. 317), in the same period as the first loom weights. The tool seems to disappear, together with the warp-weighted loom, from the Levant roughly in the first century AD.

[51] The suggestion by G. and O. Van Beek (1990) is remarkable because they suggest that the spatula was used as a kind of ophthalmic instrument to clean the eyes. Kertesz published the idea that the spatula with a rounded end was used as cosmetic stick, and the variety with the pointed end was used to puncture abscesses and clean wounds (1989:364). But nowadays it is completely clear that the sharpened thin bone artefact is related to weaving.

Fig. 3.9. Spatulas from Tell er-Rumeith.

Shuttles
A shuttle is an implement meant to keep some extra yarn on the tool itself, in order to pass it through the shed. *S*huttles are seldom mentioned in excavation reports, and thus it is not clear whether these artefacts were not much used in antiquity or that the excavators have not recognized certain objects as being shuttles. However, some bone artefacts from Tell Deir Alla and Tell er-Rumeith can be interpreted as shuttles (figs. 3.9-10). (See also Chapters 6.6 and 9.4.).
Spatulas are confusingly sometimes called shuttles. Shuttles can be distinguished from spatulas by their shape. Spatulas are straight, paper thin and pointed at one or at both ends, while shuttles have an opening or a groove at their edges in order to hold the yarn (fig. 3.10 bottom), or their shape is 'waisted' to hold the yarn (fig. 3.11 right).


Fig. 3.10. Spatula and a shuttle (bottom) from Tell Deir Alla phase IX (DA98-8-28).

The yarn to be woven had to be kept to hand. In its simplest form a length of yarn could be wound to a loose 'butterfly' of thread (fig. 3.12), or a skein with a tightly wrapped tip was inserted between the warp threads, as Scandinavian women did (Hoffmann 1974:43, 66-67, Barber 1991:106) (fig. 3.13). Balls of fine yarn are known from Egypt, wrapped around a thread core and sometimes wound around pieces of pottery, which act as a foundation for the thread (Vogelsang-Eastwood 2000:278).

Fig. 3.11. Shuttle (left) and a 'waisted' spatula from Tell er-Rumeith.

The materials we would usually expect yarn to be wound around are bone and wood because they are smooth and easy to handle. Barber (1991:107-108) points to the use of spindles as some sort of spool or bobbin around which the warp is wrapped. She showed convincingly that Greek illustrations and texts confirm this idea.

To solve the problem of holding extra yarn whilst weaving it is also possible to use a tool that combines the aspect of holding yarn (weft thread) and passing the thread through the warp. Such a tool is the shuttle.

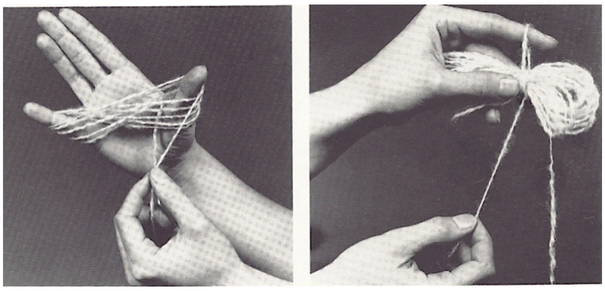


Fig. 3. 12. Thread butterfly used in weaving (after Gerritsen-Veen 1983:12).

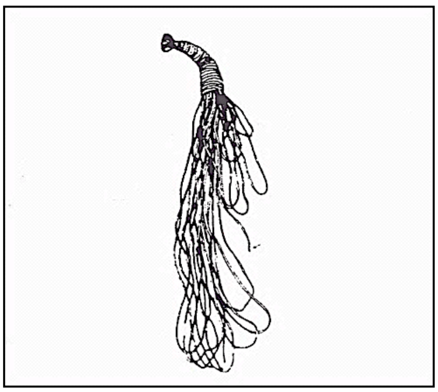


Fig. 3.13. Pointed skein (Hoffmann 1974).

3.3 Origin and spread of the warp-weighted loom

The work of Marta Hoffmann (1964), Margrethe Hald (1980) and Elisabeth Barber (1991) has shown that the warp-weighted loom was an innovation in textile production that started in the Early Neolithic (c. 5000 BC) in Central Europe (Hungary), from where it spread along the river Danube and into Late Neolithic Switzerland (c. 3000 BC), where very artistic and technically complex textiles were produced (see below). Evidence for the warp-weighted loom consists mainly of the presence of loom weights. Following the trail of the excavated loom weights shows where and when the warp-weighted loom was used.

The general conclusion is that beyond doubt the warp-weighted loom is a western invention that spread from Europe into the Southern Levant, where it formed the basis of a strong Levantine textile tradition.

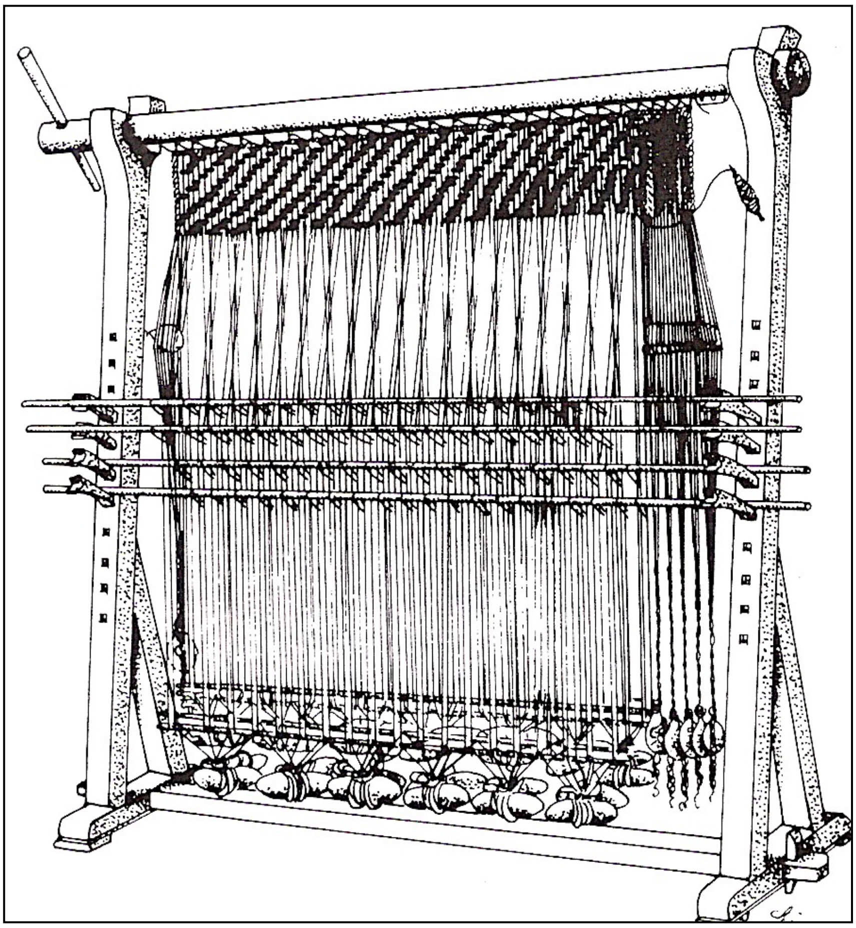


Fig. 3.14. Reconstruction after Schlabov (1976) showing the possibility of using more than two rows of loom weights, operated by different shed rods, in order to create a patterned twill weave.

Advantages of the warp-weighted loom

The warp-weighted loom as described above can be regarded as an innovation in textile production. The weft produced on the warp-weighted loom is recognizable by the use of a starting border. The substantial advantages of the warp-weighted loom over previous weaving technologies are the possibility of extending the warps, ease of transport of the loom and greater production rates, together with technical advances such as pattern weaving (figs. 3.7 and 3.14).

Twill weaves requiring more rows of warp threads to create the crossing thread pattern in the weft can easily be produced on the warp-weighted loom by using more than two rows of loom weights. The warp threads of the loom could be lengthened, enabling pieces of cloth to be woven that were far longer than the height of the loom. The flexible hanging warp threads made pattern weaving easier, and the tension on the warp could be adjusted (within limits) by changing the weight of the loom weights or the number of loom weights used for a number of warp threads. Tapestry weaving, which involves the creation of patterns or pictures, requires a loom in which portions of the shed can be opened easily (figs. 3.14 and 3.15); this is possible on a warp-weighted loom in which the weights keep a constant tension on groups of warp threads (Browning 1988:165).

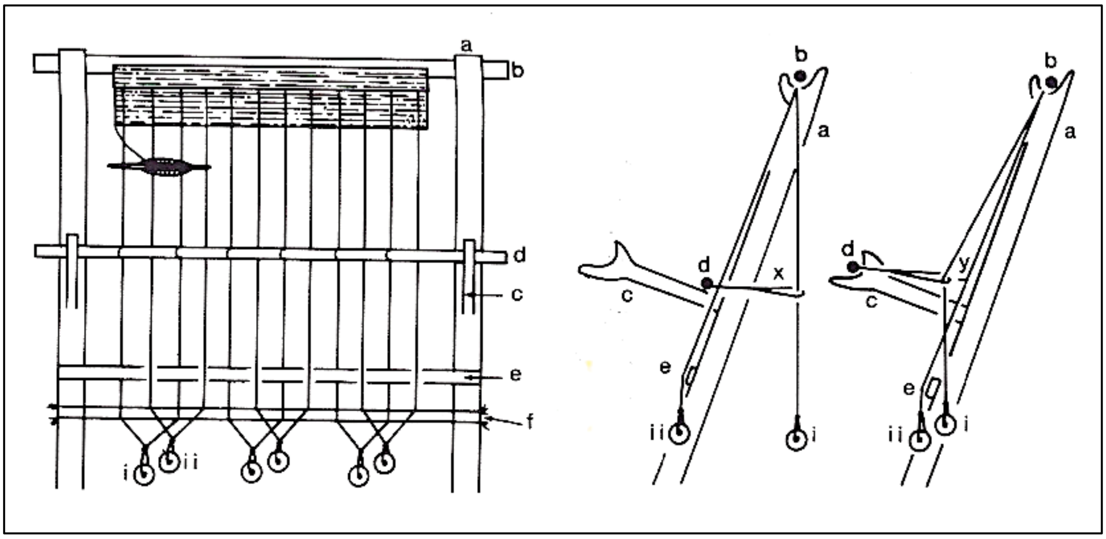


Fig. 3.15. Stylized loom plan of the warp-weighted loom (after Wild 1970). a. uprights; b. cloth beam; c. heddle to hold the heddle rod; d. heddle rod; e. fixed shed rod; f. spacing cords; Side view x natural shed; y artificial shed

Central Europe
The first area in which early remains of the warp-weighted loom occur is Hungary. From the Early Neolithic (6th century BC) onwards, and incidentally all the way down to the medieval period, loom weights have been found at different sites. The loom weights were about 5 cm high and formed as truncated cones or pyramids, and from the Middle Neolithic onwards some loom weights were decorated (Barber 1991:93-95). In Switzerland, loom weights have been found from the Late Neolithic onwards. The excavation of ancient pile dwellings revealed demonstrable looms, consisting of two posts set half a meter apart with dozens of loom weights lying between them. Impressive amounts of large conical loom weights have been excavated at different places in Switzerland, as well as the remains of flax working at every stage of production, from the raw material through spun threads to finished cloth. Some of the loom weights were very heavy, ranging from 500 to 1000 g, showing evidence of wear around the perforation holes (Barber 1991:95).

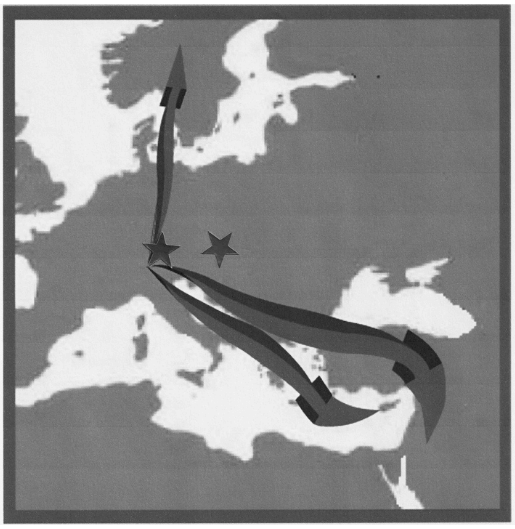


Fig. 3.16. Origin and spread of the warp-weighted loom.

In Switzerland, the warp-weighted loom was already part of the standard household equipment. On these warp-weighted looms intricate linen textiles were made, with complex patterns. Barber (1991:134) says: 'The basic weave is a balanced plain weave, in various grades and widths. The two really striking features, however, are the pattern weaves and the great variety of borders.' The finds from Switzerland reveal that the weavers were very skilled. The fine linen textiles from Robenhausen, Schaffis, Lüscherz, Murten and Ingenhausen (Keller 1866:323, 333; Vogt 1937 fig. 86, 118; Barber 1991:133-141, figs. 4.10-4.20) can be regarded as the work of master weavers, dating to about 3000 BC.

Presumably the technique spread westwards up the river Danube corridor, but how it spread between Hungary and Switzerland is not at all clear (fig. 3.14). Numerous Neolithic loom weights have been found in Romania, and various types of loom weights have been reported from Bulgaria. It is interesting that the usual truncated pyramids are found together with flattened pyramids, disc-shaped weights and also non-perforated dumbbell-shaped weights. At the Late Neolithic site of Voyvodina, in northern Serbia, where colourful and skilled textiles were produced, all these different types of loom weights have been found. From the Chalcolithic period, loom weights have been found in the Ukraine, as far east as Kiev (Barber 1991:98-99).[52] In the Early Bronze Age, conical and donut-shaped loom weights from the former Czechoslovakia are reported (Hoffmann 1974:388; Barber 1991:101 fig. 3.22). Loom weights and very sophisticated textiles, woven in complicated twills and with intricate borders, have been found in Austria and Switzerland, and extended into eastern France, south Germany and Hungary during the 1st millennium Hallstatt culture. The use of the warp-weighted loom then spread north into Poland and Scandinavia. In Scandinavia the warp-weighted loom was used until circa AD 1950.

Spain
Highly standardized loom weights have been found from the Late Neolithic onwards in Spain (Thomas 2009: 2, fig 1a.). Barber also mentions finds from the Bronze Age (Barber 1991:100).

Italy
Italy has yielded many loom weights, recently published by Margarita Gleba (2008). Cylindrical and conical loom weights have been reported from the Neolithic (5th- 4th millennium BC) onwards. During the Bronze Age new types of loom weights appear in northern Italy, such as ring-, bell- and donut-shaped loom weights. In the 1st millennium, discoid and lentoid loom weights have also been excavated. Occasionally loom weights were decorated and painted. In Italy, loom weights were used until the Roman period, and their weights varied from less than one hundred grams to several kilograms (Gleba 2008:127-138). Hellenic colonists brought a new type of conical loom weights to Italy, which became popular in the 6th century BC, especially in southern Italy.

Greece
Since the Middle Neolithic, Greece has been famous for its cloth production and many loom weights have been found. Towards the very end of the late Neolithic, tall and heavy loom weights begin to spread through northernmost Greece (Barber 1991:100). From the finds of Late Neolithic Greece, Carrington Smith concludes that the warp-weighted loom was always more prevalent in the north than in the south. Late Bronze Age loom weights have been found at the Aegean town of Akrotiri (Thera). These are small discoid loom weights of remarkable uniformity, of a well-known Minoan type; identical loom weights have been found at Crete, at Knossos, Malia and Palaikastro, and on many of the Aegean islands and in mainland Greece (Tzachili 2007:191).Conical loom

[52] There are some geographical gaps in the finds of loom weights from the Early Neolithic in some parts of central Europe, but this might be due to lack of investigation of loom weights in countries such as the former Czechoslovakia and the former Yugoslavia (Barber 1991:303 note 6). Early Bronze Ages donut-shaped loom weights from Czechoslovakia are reported by Hoffmann (1974:388) and Barber (1991:101 fig. 3.22).

weights have been reported from Athens, Corinth and Olynthos (Gleba 2008:131). Coarse spool-shaped loom weights were found in the Late Bronze Age levels of Ayri Irini (Keos), Lerna, Phylakopi and Asine (Gleba 2008), and from Kastanas (Hochstetter 1987:90) and Tiryns (Rahmsdorf 2003). Painted loom weights have been found in Athens (Gleba 2008:137).

Crete

Evidence for spinning and weaving begins towards the end of the Middle Neolithic (c. 4000 BC) when double pierced rectangle loom weights are reported from Knossos, weighing around 200-300 g (Barber 1991:1000) and in Kato Zakros (Platon 1971:57, 191, 281). Barber studied the Late Neolithic (c. 3000 BC) loom weights from Knossos, which are oblong, pyramidal and conical, with weights ranging from 350-635 g (Barber 1991:100). At Knossos, Early Minoan I and II (3000-2200 BC) loom weights are dome-shaped or of the cylindrical type; they are unbaked or poorly fired (Burke 2010:25). Early Minoan Myrtos yielded discoid loom weights with one to three perforation holes. Loom weights were also found in Early Minoan IIB Fournou Korifi and Early Minoan III Vasiliki (c. 1900 BC), (Burke 2010:27-31, figs. 16, 34 and 35). Spherical loom weights occur on Crete only during the late Middle Minoan and Late Minoan II periods, and these weights are approximately the size of an orange. Their weights range between 86 and 710 g. They have been found in Neopalatial sites such as Akrotiri, Kythera Kea, Rhodes, Mylia, Archanes and Knossos (Burke 2010:51-52, fig. 35). Cuboid or block-shaped loom weights with four perforation holes were also used on Crete, with weights ranging between 67 and 284 g. This type of loom weight has also been found in Neolithic Knossos, whilst in the later Middle Minoan period, cuboid loom weights were concentrated in eastern Crete (Burke 2010:58-60, fig. 38).

Anatolia

At Ulucak Hüyük in western Anatolia, stamped objects from the Neolithic period have been interpreted as loom weights (Çilingiroglu 2009:3-27). At Çatal Hüyük, Mellaart found a few rough clay loom weights 'like an apple with a hole poked through' (Barber 1991:99). Burnham thus suggests that the use of warp-weighted looms may be assumed as early as 6000 BC, but the dating of these finds is debatable (Cecchini 2000:213, note 7). At the Chalcolithic site of Alishar Hüyük, pyramidal loom weights have been excavated.

From the Early Bronze Age II and III there are clear traces of the warp-weighted loom in Anatolia (Cecchini 2000:213; Barber 1991:99). In Central eastern Anatolia loom weights appear later: cylindrical reels were used as loom weights in the Late Bronze Age at Alishar Hüyük, Tarsus and Tille Hüyük (Cecchini 200:217). Mellaart also excavated Late Bronze Age loom weights from the Hittite cemetery at Gordion. According to Burke (2010:111) they are '...shaped somewhat like a curved banana and pierced through both ends.' (Burke 2010:111, fig. 55). Crescent-shaped loom weights are known from Bronze Age excavations at Karahöyük, Konya and Demircihöyük. From the weaving experiment by Agneta Wisti Lassen with crescent shaped loom weights, we know that twill-woven textile (see Chapter 2) could be produced on warp-weighted looms with such light crescent-shaped double-pierced loom weights (Wisti Lassen 2010). Early Iron Age non-perforated cylindrical loom weights have been excavated at Tell Tayinat on the plain of Antioch (Harrison 2009). The Iron Age loom weights of Gordion (c. 800 BC) are famous because of the striking numbers found at this site (over 2300). These loom weights are predominantly donut-shaped, but ovoid, conical and cylindrical loom weights have been recorded as well. Their average weight is about 500 g, the majority of the weights ranged from 400-700 g (Burke 2010:116-118, fig. 61). From the Hellenistic period pyramidal and lentoid loom weights, the latter with two suspension holes, have been found at Ephesus (Trinkl 2008:82-83, figs. 13.1 and 13.2).

Cyprus

The first loom weights were found together with spindle whorls at Kissonerga, dated to the Late Chalcolithic period. These loom weights are perforated and dome-shaped (Webb 2010). Unfired spool-shaped loom weights are reported from sites dated to the 12-11th century BC (Karageorghis 2002:93-100). At Maa, Palaeokastro (Karageorghis and Demas 1988:222, plates LVI. LIV, LXV), and in temple precincts at Enkomi and Kition, spool-shaped loom weights appear together with perforated loom weights (Stager 1995:346).

Egypt

It seems that the warp-weighted loom was never used in Egypt and that weaving traditions developed separately from those in the Levant (Kemp and Vogelsang-Eastwood 2001:392-394). Though some authors mention the use of 'loom weights', it should be noted that these weights from Egypt were not been used to stretch the warp threads of the warp-weighted loom; instead they were heavy weights used on the horizontal two-beam loom to give tension to the lower beam.[53] These weights are comparable to the weights that were (and still are) used on the treadle loom (Dalman 1937:90; Weir 1970:30, plate 24). The function of the loom weights on the two-beam vertical and treadle looms is totally different from that of the warp-weighted loom. The weights of the treadle loom are tied in one row only, to both the odd and the even numbered ends of the warp, and therefore cannot be used to shed the loom (Staermose Nielsen 2005:134, fig. 23.4). The isolated linen-weaving tradition in Egypt, combined with the peculiarities of the ground loom, led to a conservative and specialized set of weaving techniques (Barber 1991:211).

Levant

The warp-weighted loom travelled southwards from Switzerland, Hungary, Bulgaria and Romania and spread throughout the Aegean, Cyprus and Anatolia and into the Levant where it arrived in the Early Bronze Age. The increasing numbers of loom weights used in the Levant during the Iron Age in combination with the appearance of bone spatulas show that the sophisticated pattern techniques, already practised in Central Europe since the Neolithic, conquered the Levant during the Bronze and Iron Ages (see further Chapter 5).

The warp-weighted loom became very popular in the Levant during the Iron Age. In the Persian Period the warp-weighted loom was still used intensively, whilst in the Hellenistic period this kind of loom was still in use, although the form and weight of the loom weights changes dramatically, as can be seen in the collection of Tell Mazar (Chapter 7). These are small, donut-shaped and spherical, pyramidal or square loom weights, with tiny perforation holes of only 0.5 cm. Their weight decreased to less than 100 g. In the Roman Period, light and small loom weights were still in use; their type is comparable to those of the Hellenistic period (Sheffer 1981:81-83; Sheffer 1989:6; Shamir 1994:230). The vertical two-beam loom gradually replaced the warp-weighted loom (Barber 1991:125) and at the end of the first century AD the use of the warp-weighted loom ceased entirely (Shamir 1994:265-282; Shamir 2007b:381-390). The new vertical two-beam loom was probably preferred because the weft could be beaten with a downward movement and therefore the loom could be operated while sitting.

Nowadays warp-weighted looms are not used in the Levant. Various weaving techniques were used simultaneously in time and place, and only a few of these techniques can be traced in the archaeological record.

[53] Except for the supposed limited use in Lisht during the New Kingdom (Forbes 1956:200 note 30). According to Kemp and Vogelsang-Eastwood (2001:392-394) the warp-weighted loom was not used at Amarna, and the weights found there were used on the vertical two-beam loom. They keep the possibility open that the weights from el-Lisht were indeed loom weights.

Chapter 4 Loom weights as a research tool

4.1 Introduction

Loom weights exhibit a wide variety of shapes and other characteristics and may have wider implications for cultural history than merely indicating that a loom was present. They function as stretchers and spacers of the warp threads on the warp-weighted loom. Therefore their shape and weight are of technical importance in weaving. Some differences in the shape of loom weights are of importance to the weaving technique or are of cultural origin; others originate from the way in which the loom weights were made.

Loom weights were made of various materials such as stone or clay, and even metal loom weights have been reported from Greece.[54] No metal loom weights have ever been found in the Levant, however. Clay loom weights were sometimes fired, resulting in durable terracotta weights, but the majority were made of unfired clay. Unlike Staermose Nielsen (2005:130), who states: “Groups of unbaked clay weights are the more numerous of all, but as clay loom weights reveal themselves on excavations only as disintegrated lumps, their usefulness in a classification is minimal.” For many excavations Staermose Nielsen is right. But that is because of the way the weights are excavated rather than preserved in the ground. I will demonstrate that clay loom weights, when properly excavated and preserved, can be classified and studied in a meaningful way, enabling us to reconstruct textile production. According to Glenda Friend (1998:11), “loom weights offer a window into the life of ancient artisans, answering questions about where they worked, what tools they used and what products they manufactured”. Because of their ubiquity, loom weights are the main key to the study of textile production in the Iron Age in the Levant.

To study the technical weaving aspects of loom weights, it is important to securely register and document the position in which the loom weights were found (see also Chapter 2). In analyzing the loom weights from excavations the following strategy was used. To determine whether a group of loom weights belonged to one loom, square and locus (the find spot) were taken as selection criteria. This narrow definition of a loom is necessary because the stratigraphy and interpretation of the different loci is often very complex. Using this criterion allows us to recognize the looms without a detailed stratigraphy. It limits the numbers of weights within the groups and the number of groups possibly representing a loom, but it reduces illogical interpretation of scattered loom weights without a clear function. In the following chapters, any group of loom weights from one locus consisting of more than 10 weights is considered to represent a more or less complete loom. The choice for a minimum of 10 loom weights on a loom is based on experiments with loom weights from various sites. It is known that about 20 warp threads are tied to a cord in the loom weight (Shamir 1996:144; Sheffer 1980; Kelm and Mazar 1995:163; Shamir 1994:282; Broudy 1979:26; Hoffmann 1974:314). These numbers make weaving possible without distorting the warp in such a way that holes would appear in the textile.[55] With less than 10 weights the cloth will be too narrow (less than 20 cm) to make it worthwhile for the weaver to go through the trouble of setting up his/her warp-weighted loom. If such a narrow piece of fabric is wanted, other weaving methods would be chosen (see also Chapter 2).

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[54] Metal loom weights have been reported from Corinth-Isthmia (Raubitschek, 1998: 112; Davidson 1952;), Athens and Olynthus (Raubitschek, 1998: 112 notes 21-23; Davidson and Thompson. 1943). A lead loom weight with a design of an owl and the Greek letter alpha from 4th-century BC Corfu is in the collection of the British Museum (no. 1868.0110.117).

[55] Using 10 loom weights gives 10x20 threads in the fabric, compared to the thread count of the textiles from Kuntillet Ajrud (Sheffer and Tidhar 1991:5-19) this is an average count (20 tpc), it results in a piece of cloth with a width of about 20 cm.

4.2 Simulation experiment in the context of a technological study of Levantine Iron Age clay loom weights

The shaping of clay loom weights has not been part of previous research and, in order to design a typology for clay loom weights, this aspect had to be studied first. To determine how form and weight of loom weights could have been influenced by the way in which they were manufactured, a simulation experiment was performed. The experiment showed that it is possible to distinguish between traces originating from manufacturing techniques and traces left by the use of loom weights.

The clay and temper of Deir Alla loom weights were analyzed and compared to fabrics used in pottery production, the conclusion is that the same kind of fabrics were used to produce pottery and loom weights. From the study of the shaping process and the materials used to produce the loom weights it was possible to determine a new typology based on technological criteria.

Typologies of loom weights are usually based on the well-known typology designed for beads (Beck 1928). This typology is based on the shape of the objects.[56] To study clay loom weights using a typology based on the form of stone beads does not seem relevant because beads and loom weights were used for different purposes and their proportions are very different. A typology designed for loom weights based on technical criteria did not exist. I decided to study the manufacturing techniques of a number of Iron Age clay loom weights and the way in which they were manufactured and used (fig. 4.2). In this context a simulation experiment was carried out. The results from this experiment form the technical basis for my loom-weight typology.

The simulation experiment was based on the study of 588 Iron Age loom weights from Tell Deir Alla Phase IX (see further Chapter 6). The first objective was to study primary shaping techniques to devise a typology. The second objective was to find out why and how different types of loom weights were made. Technological information was needed to determine how the form and weight of the loom weights could have been influenced by the way in which they were manufactured. The experiment also analyzed traces of use and differentiated signs of use from traces of shaping techniques. The experiment with local clay was carried out when the temperature was 18-25° C. Twenty-two loom weights were made (Fig. 4.1).

Fig. 4.1. Loom weights from the experiment.

[56] Shamir (1996:136) mentions Beck as her typological source, resulting in fourteen different loom weight types. Glenda Friend does not mention Beck but she bases her typology on the work of Shamir (1998:1). She describes nineteen different types of loom weights (1998:71). A typology based on technological criteria will result in a smaller number of types.

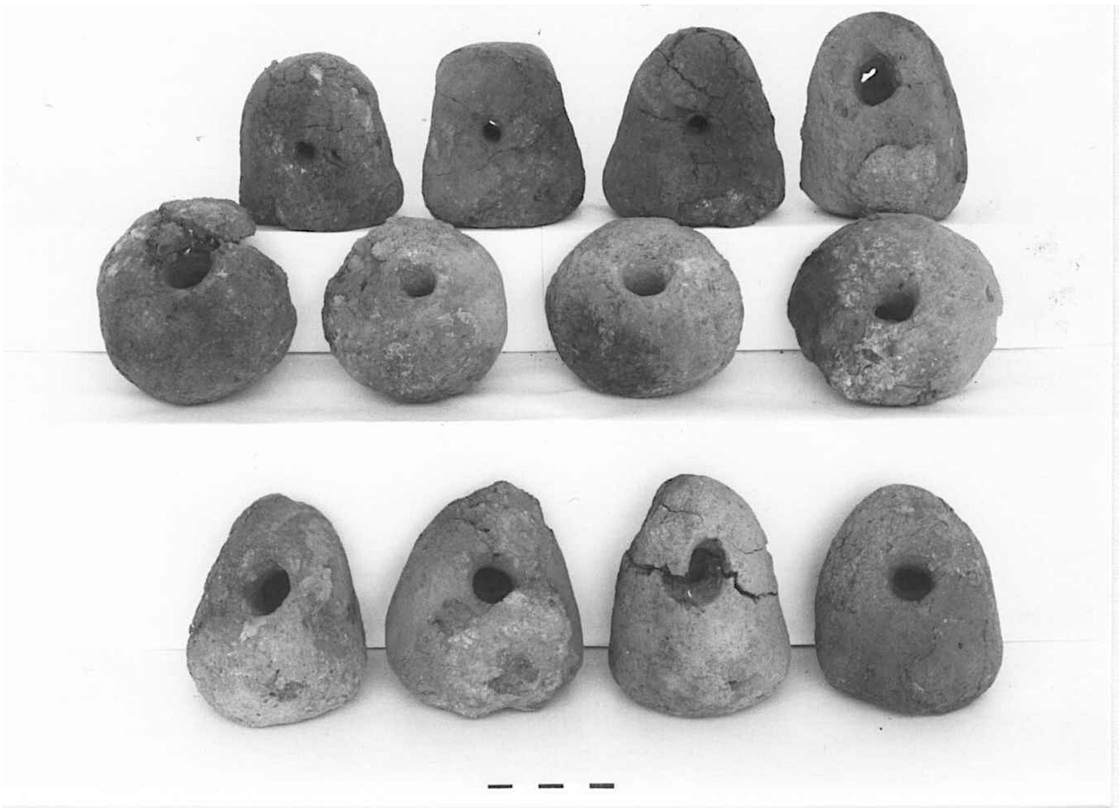

Fig. 4.2. Loom weights from Iron Age Deir Alla.

Analyzing the clay

As it seemed logical that local clay was used to make the loom weights, information about local pottery fabrics was gathered. The clay from Deir Alla has been described by Franken and Kalsbeek (1975), Franken (1992), Vilders (1992) and by Groot (2007, 2010; Groot and Dik 2008). Its major components are clay particles, which are a form of mudstone. These mudstone particles, generally of a reddish/brownish colour, do not completely fall apart when soaked or when mixing is insufficient (Franken 1992:106-107; Groot and Dik 2008:106). This type of clay is referred to as *banded clay* (Franken 1992:106-107). Groot (2007:100) describes the local clay source as a part of the Damiyah/Lisan formation, consisting of a sequence of differently coloured clay layers. He distinguishes three types of fabric in the pottery:

- Fabric 1 is characterized by a high percentage of non-plastics, such as quartz sand, mudstone and a high amount of fibre.
- Fabric 2 is characterized by mudstone and lime.
- Fabric 3 is characterized by small elements of lime and some mudstone; this might indicate that the potters did not use the clay indiscriminately, but deliberately choose certain fine-grained clay layers within the Damiyah/Lisan formation.

The Damiyah/Lisan formation is easily accessible, due to the presence of outcrops in the vicinity of Tell Deir Alla (Van der Kooij and Ibrahim 1989:76). A thick layer of this clay is still accessible about 1.5 km east of Tell Deir Alla along the river Zerqa. The 588 studied loom weights from Deir Alla exhibit the characteristics of this clay.

The clay and temper of Deir Alla loom weights were analyzed with a magnifying glass. After the different fabrics were established within each group, a loom weight was cut and the fresh surface re-analyzed by magnifying glass to confirm the result.

When analyzed, the fabrics of the loom weights show the same characteristics as the three fabrics described above:
- Fabric 1 (quartz sand, mudstone and vegetal matter) was used in 54.7% (n=321) of the loom weights.
- Fabric 2 was used in only 2.2% (n=13) of the loom weights
- Fabric 3 (small elements of lime and some mudstone) was used in 22.4% (n=132) of the loom weights.
The other loom weights were made of the following clay mixtures:
- 19.9% (n=117) of the loom weights were made of fabric 1, additionally tempered with limestone, varying in size between 4 and 15 mm (see fig. 4.3).
- Lastly, 0.8% (n=5) of the loom weights were made of fabric 3 additionally tempered with grog.[57]

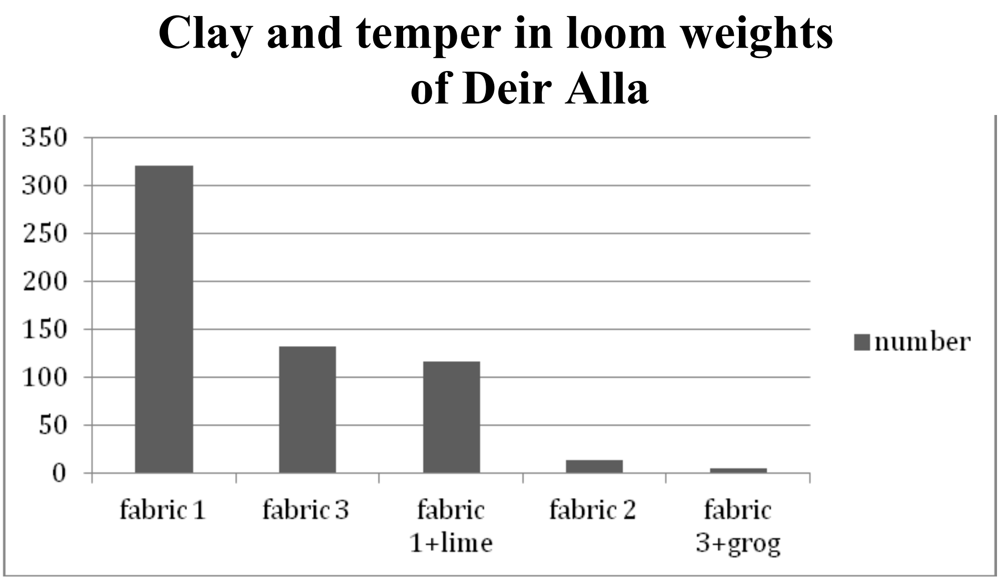

Fig. 4.3 Limestone visible in loom weight.

[57] Grog is a temper made of crushed pottery sherds.

Conclusion: The loom weights were made of the same fabric that was also used to produce pottery. In 20.7 % of the cases some kind of temper was added to the clay matrix. Nearly a quarter of the weights (22.4%) were made of specially selected finely levigated clay (fabric 3). The excavated loom weights often include organic material and sand together with small and large stones. The clay in the excavated loom weights sometimes looks as if it was not well mixed, making it difficult to tell whether non-plastics were added or part of the original clay matrix. This is comparable to what Franken wrote about the Late Bronze Age pottery from Deir Alla: 'Imperfect mixing of the clay with non plastics during preparation of the clay by the potters is another factor that makes it difficult to say exactly how much material was added by the potter.' (1992:107). See also the remark by Kalsbeek (1969:74): 'The use of an impure clay does not necessarily point to a lack of skill of the potter, but may be due – at least partly – to shortage of water.' This is also applicable to the loom weights.

Manufacturing the loom weights

The following simulation experiment was carried out with local Damiyah/Lisan clay. No extra mineral tempering material was added to the clay, because the clay as collected was good plastic clay as described by Kalsbeek (1969:74).[58]

Collecting the clay. The clay used for the experiment is a local banded Damiyah/Lisan clay found in the vicinity of Tell Deir Alla. The clay was not specially selected. Stone, sand and organic materials were left in the clay.

Crushing the lumps of hard clay. Because of the presence of undissolved clay particles in the clay, crushing was needed to make a workable mixture.

Adding water to make a workable clay mixture. The ancient loom weights show signs of being made of a dry clay mixture. Therefore, in the experiment the clay was kept rather dry. For some shapes, however, more water had to be added during the shaping process.

Kneading the clay. In the Deir Alla collection, a small number of smooth structured loom weights were made of selected and thoroughly kneaded clay. Most loom weights, however, were made of clay with varying amounts of stones, sand or organic material. In the experiments, two series of loom weights were made: group 1 with slightly kneaded clay (9 loom weights) and group 2 with thoroughly kneaded clay (13 loom weights).

Preparing the clay balls. Each piece of clay weighed about 350 g. This is the average weight of Iron Age loom weights (Shamir 1996:140).

Shaping the loom weights. Different shapes of loom weight were made:

- *Conical* --- A piece of clay on the left palm of the hand was pressed together with the fingers and thumb of the other hand into a conical form with a rounded base (fig. 4.4). The conical loom weights with a flat base were made on a flat surface (fig. 4.1 upper row).

It was very surprising to see that the most 'illogical' formed loom weight (the conical loom weight) was formed in such a simple way (fig. 4.1 row 3). The distinction between the two types of conical loom weight appears to be of no interest at all; it is actually the same form, made on different surfaces.

[58] The following test showed that the clay was good plastic clay. 'A simple test can be done on natural clay found near an excavated site, to find out about the plasticity of the material. After mixing some clay with water until it is kneadable, a roll is made 15 cm long and 1 cm in diameter. One lifts the roll holding one end between the fingers, while the other end can swing freely. If the clay roll breaks off the clay is not plastic. If the roll does not break, and if it is possible to wind the free end like a snail's shell, without causing the clay to crack, it is a very good plastic or unctuous clay.'(Kalsbeek 1969:74).

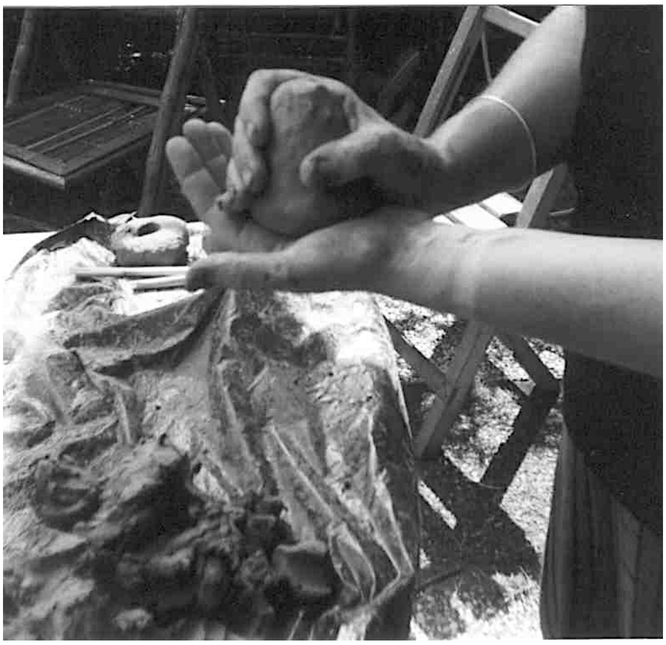
Fig. 4. 4. Forming the conical loom weight.

- *Beehive* --- The beehive form was made like the conical form. The base and upper part, however, were flattened. This type always has a very small perforation halfway up the loom weight (fig. 4.1 upper row second left). The hole is very small because the warp threads were not tied through the perforation, rather an intermediary was attached to the weight, such as a stick, a rod, a ring or a loop of some strong material to fasten the warp threads to the loom weight. A pyramidal loom weight with an elliptical bronze ring (of uncertain origin) can be found in the British Museum (Davidson and Thompson 1943:68 fig. 30). At Nemea in the Peloponnesus, conical loom weights have been found with a stick inside the perforation (McLaughlin 1981:74). The image of similar rods used inside loom weights was found stamped upon four loom weights from Corinth, Myrna and Athens (Davidson and Thompson 1943:39:139; Davidson 1952:148 no. 4, fig. 25 no.1145) (fig. 4.5). At Masada, Shamir found loops made of linen, goat hair or date palm fibres preserved around the loom weights (Shamir 1994a; 1996:147).

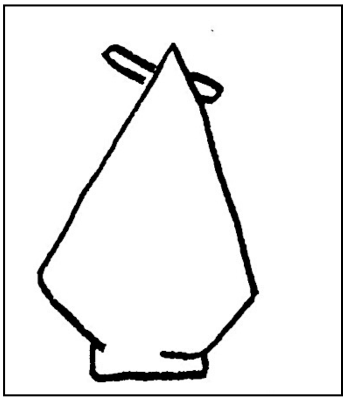
Fig. 4.5. Loom-weight stamp used on four loom weights from Corinth (after Davidson 1952: fig. 25 no.1145).

- *Donut* --- The donut-shaped loom weight was easily made by winding a coil of clay around a finger. This gives a donut shape with a maximum diameter of 9 cm (fig. 4.6 and fig. 4.1 middle row). A coil about 15-18 cm long and 3 cm thick could still be worked around the finger, but longer or thicker coils were impossible to use in this way. Big donut-shaped loom weights (with a diameter of over 9 cm) were made in a different way. In this case a spherical piece of clay was perforated with a stick. The donut was smoothed with wet hands to make a regular form. If clay was pressed out of the perforation at one side, this clay was pressed away on the surface of the donut.

Fig. 4.6. Thirty-three and a half donut-shaped loom weights from Deir Alla.

- *Spherical* --- Although Friend (1998:9) suggested that '..the ball shape was easier to make..', it turned out to be rather difficult to form a clay ball of 350 g into a smooth spherical shape (fig. 4.3). In addition, perforating the ball with a stick to shape the perforation hole tended to deform the spherical clay form. During the drying process the spherical forms easily developed deep cracks. These cracks had to be repaired when the clay was leather-hard.

- *Cylindrical* --- Working on a hard surface, a spherical form could quickly be rolled into a cylindrical form (fig. 4.7). It was not easy to perforate the cylinder-shaped clay.

Fig. 3. 7. Cylindrical loom weight from Deir Alla.

- *Wheel* --- To form a wheel-shaped clay weight (fig. 4.8), a clay ball with a stick in the centre was placed on a hard surface. The clay was then pressed in the direction of the stick and squeezed against the stick (fig. 4.9). The stick was then tilted. Rolling the wheel over the surface smoothed the surface of the weight. At the same time the perforation widened into a conical form. Pulling out the stick gave the loom weight a typical truncated top. The shape often became asymmetrical. The wheel shape appeared to be a quick way of making a loom weight. Since wheel-shaped clay weights are thinner than spherical or cylindrical weights, there were not many problems during the drying process. The wheel-shaped loom weight is a thin loom weight that can be used when heavy but thin weights are required.

Fig. 4.8. Wheel-shaped loom weights from Deir Alla.

Fig. 4.9. Forming the wheel-shaped loom weight.

- *Mixed* --- Of the 588 loom weights studied, 29 (4.9%) show mixed characteristics (fig. 4.10). These weights are 5 to 7.5 cm in diameter and their perforation hole is 2 cm in diameter. A mixed form can be explained as the result of a combination of two basic shaping techniques or a final finishing technique. The following combinations of techniques could be distinguished (see Table 4.1).

Spherical worked out as a cylinder	n=9
Spherical worked out as a wheel	n=2
Donut worked out as a cylinder	n=6
Donut/wheel	n=5
Donut/spherical	n=2
Donut/conical	n=2
Wheel/cylinder	n=1
Donut/cylinder/spherical (three in one)	n=1
Donut/cylinder/wheel (three in one)	n=1
Total	*29*

Table 4.1.Twenty-nine loom weights with a mixed form made by different combinations of techniques.

The wheel-shaped loom weight and the cylindrical loom weight are shaped out of a donut form. In the collection of Tell Deir Alla this is visible in various weights that show both or even the three forms in one weight. The same situation is found in the loom weights of Tell Mazar (see Chapter 7).

Fig. 4. 10. Mixed forms. (See also Chapter 7 Tell Mazar,Ttable 7.3 and fig. 7.4).

Perforating the weights

The perforation hole in the loom weight can be made in two ways. A coil of clay is wrapped around a stick or a finger whilst shaping the weight, or the hole is made afterwards by perforating the finished object with a stick. The use of a stick from one side often leaves characteristic traces (fig. 4.11). The size of the perforation depends on the way the hole is made, from one or from two sides: and on the thickness of the stick. Before the stick is taken out of the weight it can be twisted (fig. 4.12), resulting in a hole with a conical form at one side. The perforation from two sides leaves typical traces inside the loom weight. Perforations wider than 2.5 cm in diameter are always made from two sides in all types of loom weights.

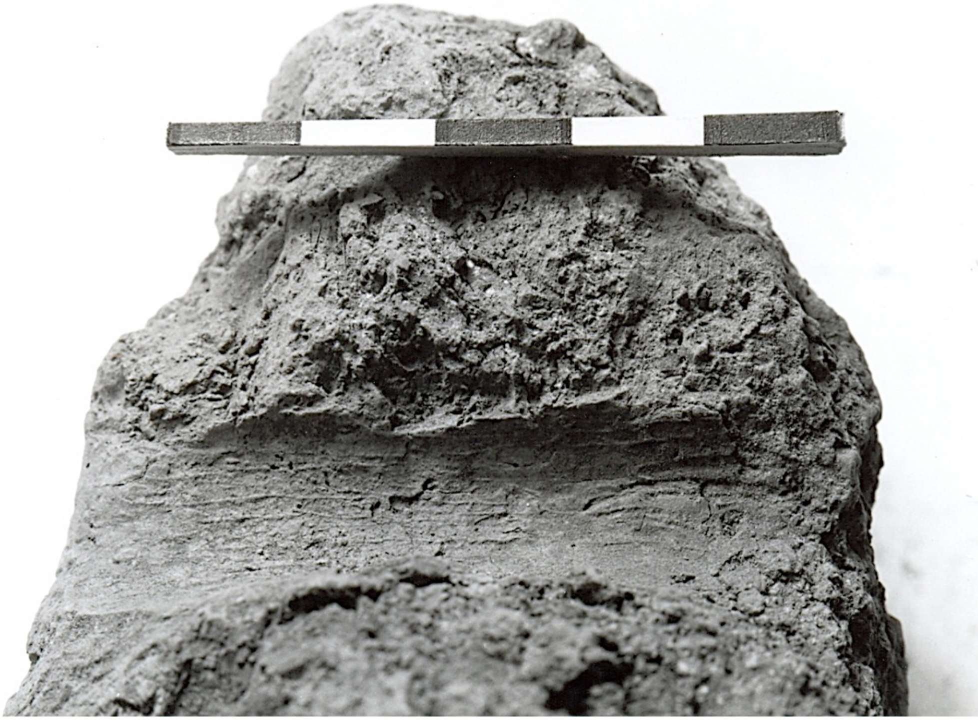

Fig. 4.11. Conical loom weight with traces of the stick that was used to create the perforation.

Smoothing the surface
When leather-hard, the clay weight can easily be smoothed with wet hands. This way, small cracks can be mended.

Drying
To prevent the development of drying cracks, loom weights have to dry slowly, drying them in the sun as described by Macalister (1921:73) and Shamir (1994a:37; 1994b:270[59]; 1996:136), and suggested by Bienkowski (1995:89) is unlikely. Drying has to be in the shade, as potters do with their pots. Fast drying in pottery production results in long, deep, sharp cracks, extending vertically.[60] The loom weights in the experiment were dried in the shade. After two days they were turned over. At a temperature of 18-24° C it took eight days for the weights to dry thoroughly. During the slow drying process in the shade the donut-and wheel-shaped loom weights dried nicely as did the conical and beehive-shaped weights. In the spherical and cylindrical loom weights, however, the thickest loom weights, deep cracks appeared in or around the perforation. The form of the drying cracks match those in pottery dried too rapidly (Rye 1981:66, fig. 46). If a crack results from drying, the edges tend to remain in alignment to the surface while the edges of the cracks tend to be irregular, flayed and rough as a consequence of slow development due to the thickness of the object. This kind of crack could be observed around the perforation in the cylindrical and spherical loom weights (fig. 4.2 bottom right, spherical loom weight). To avoid such problems, these weights would have needed an even slower drying process.[61] After drying, all of the loom weights showed a light scum, comparable to Orton's description of pottery made of slightly salty clay (Orton 1994:116). The clay from the Deir Alla region is, indeed, a bit salty.

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[59] Shamir performed an experiment with donut-shaped loom weights and concluded, '35 loom weights were formed from terra rossa clay, and laid in the sun. An average temperature of 25-30 degrees Celsius was sufficient to rapidly dry loom weights of adequate quality.' This experiment was limited to donut-shaped loom weights. Surprisingly, no mention is made of cracks because of the rapid drying process.

[60] 'The drying rate is related to the nature of the packing of clay minerals, which govern the size and distribution of capillaries through which water reaches the surface where it can evapourate. Because clays and bodies shrink during drying, stresses are created when one part dries more quickly than another and cracks develop.' (Rye 1988:21-24).

[61] Which could have been achieved by covering these loom weights with wet cloth or by sprinkling some water on the weights.

Fig. 4.12. Donut-shaped loom weights showing traces of rotating the stick to create and/or enlarge the perforation.

Traces of use (wear)
The next part of the simulation experiment concerned the use of unfired loom weights. For several hours threads of wool and linen were pulled through the holes of the different types of loom weights, whilst other loom weights were moved over several hours whilst hanging on a single loop of wool or linen. As in Shamir's experiment (1996:143), no clear traces of wear were visible under a magnifying glass. Because loom weights do not move that much on a loom, it will take a very long time to produce signs of wear, even in unfired weights. The traces found in the loom weights of Tell Deir Alla thus signify that they were used very intensively and for a very long period (see Chapter 6). Usage gives a smooth broad curve on one side of the weight where, due to gravitational pull, the weight pulls on the bunch of threads or on the loop connecting the bunch of threads to the loom weight (fig. 4.13).

Clay loom weights 'under fire'
The loom weights of Tell Deir Alla phase IX are made of unfired clay, but many weights were 'fired' in the fire that destroyed the village after the earthquake (Van der Kooij and Ibrahim 1989:82). To answer the question of what will happen to non-fired loom weights when accidentally fired in an uncontrolled fire, the following experiment was carried out. Eight loom weights were fired in an open fire for 1.5 hour at max. 1000° C. Afterwards the loom weights were kept in the hot ashes for another half an hour. During the firing process the organic material burned out, which resulted in the mottled colours typical of an open fire, varying from red and brown to black. Most of the weights did not collapse in the fire, even the ones made of slightly kneaded clay. Just as in the controlled firing experiment at 970° C done by Albright (1943:118), some weights became brittle due to the high peaks in temperature of the open fire.

Fig. 4. 13. Traces of wear in a donut-shaped loom weight from Deir Alla. For traces of wear in conical loom weight, see also Chapters 5, 6 and 7.

Conclusions
The experiment made clear that the loom weights of Tell Deir Alla were used unbaked and were not intended to be fired. As known from ceramic production, drying the weights has to be done slowly and not in the full sun. Thus it is incorrect to speak of sundried loom weights.
The clay used for the loom weights was the local banded Damiyah/Lisan clay, the same as for locally made pottery and bread ovens. It was difficult to tell whether the clay was used as it was found, containing organic materials and stones, or if temper was added to the clay on purpose. In some cases the ancient loom weights showed that the clay was selected and temper was added. The experiment made it clear that it was also possible to use the clay without adding temper, because the clay as it was collected already contained organic material, sand and some stones. From later research on the clay and temper of the loom weights from Khirbet al-Mudayna, additional information on the use of temper was derived, from which it can be seen that some temper was probably added on purpose as is the practice in the production of pottery, but household rubbish was also added. (Chapter 8.3)

The experiment showed convincingly that it is indeed possible to distinguish between traces originating from manufacturing techniques and traces left by the use of the loom weights. Traces of wear in loom weights will only show after long and extensive use.
Contrary to what is generally thought, the conical loom weight is actually very easy to make. The spherical / ball-shaped weight, however, is difficult to shape and dry. It is not as quick and easy to manufacture the spherical loom weight as is often suggested.

4.3 Results of the experiment

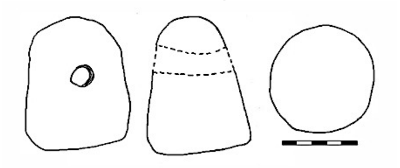
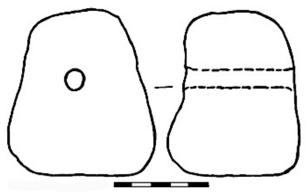
A typology based on technological criteria is fundamentally different from a classification based merely on shape. Technological analysis can explain phenomena rather than merely describing them; this simplifies the typology and increases its significance. Small variations in form, due to variation in *the repeat item*, should be ignored in a typology (Van As 1984:144). My experiment showed that the different shapes of loom weights could be explained by their production method. It would, however, be possible to apply the results of the experiment to a broader group of loom weights. Here the suggested changes will be limited to Iron Age loom weights from the Levant.

Changes to the usual typology of loom weights

The most important differences in the experiment-based typology are the result of the study of the shaping (or formative) processes (*chaine operatoire)* and result in a limited typology.

Horizontally perforated loom weights

Conical loom weights with a flat base and conical weights with a rounded base (the sack form) are in fact the same type of loom weight. The flat base is due to producing the weight on a flat working surface. When using the hand palm as a surface to shape the same type of weight, a rounded base will be made. Thus the difference in shape is the result of the work surface on which the loom weight was made, and therefore both kinds of weights can be regarded as one single group: the conical loom weight.

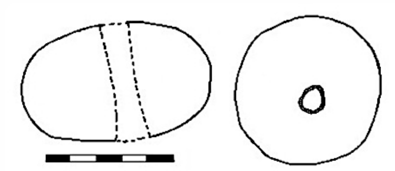
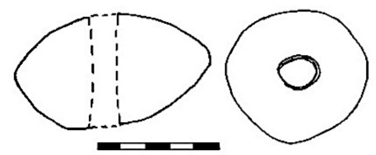
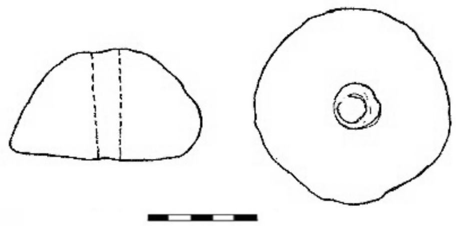
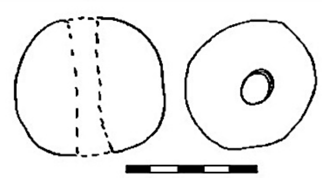
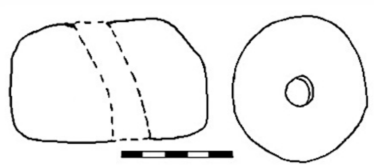
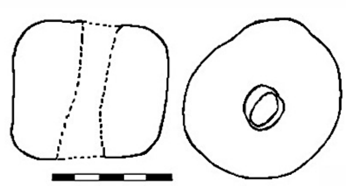
Horizontal perforation (pendant)	
Conical loom weight 	*Conical loom weight* Characteristics: Conical body with a circular or elliptical base. Diameter of the perforation varies from 0.5 to more than 2 cm.
Beehive-shaped loom weight 	*Beehive-shaped loom weight* Characteristics: Conical body, flattened top. The narrow perforation is always made with a stick in the middle of the weight measuring 1-1.4 cm in diameter.

Centrally perforated loom weights

The most common loom weights in the Iron Age sites of the Levant are the donut-shaped weights. Donut-shaped loom weights are divided into two main groups, based on the method of production:
1. Regular donut-shaped weights measuring between 5 and 9 cm in diameter were formed around the finger. Some of these weights have a biconical shape, the result of holding the weight in the hand while perforating it, while others show a more or less round donut-shaped form. Biconica*l* loom weights are therefore not a special type of loom weight, they belong to the group of donut-shaped loom weights.
2. Large donut-shaped weights, over 9 cm in diameter, cannot be formed round the finger. The weights were made in a different way because the clay cone is too long to be wound around the finger, therefore the weight will be shaped on a flat surface causing one more or less flat side, and the large donut-shaped loom weights were always perforated with a stick.

Centrally perforated loom weights with a diameter of between 5 and 7.5 cm were all produced using the same technique, resulting in a group of loom weights of mixed type, containing donut (including biconical) and spherical weights, small wheel-shaped weights and cylindrical weights.

The mixed forms were shaped as a donut or a spherical weight, but when still wet were rolled on a hard and flat surface causing a flattening of the original shape. However, because the process was not always completed in the same way, the result is a group of loom weights with irregular shapes, composites of the donut, spherical, cylindrical and wheel shapes (Boertien 2004:313-314, 327; 2009a:37). This group is recorded as mixed type.

Central perforation	
Donut-shaped loom weight  a  b	*Donut-shaped loom weight* *Characteristics:* the weight was made from a coiled piece of clay < 9 cm, the coil was wound around the finger to create the shape. Width is 1 cm wider than height and always under 9 cm. Perforation diameter is 1-2 cm. a. Donut-shaped loom weight (regular). b. *Bi-conical weight*: a donut-shaped loom weight. The elliptical shape is non-discriminating; the weight was made in the same way as the donut-shaped weight, resulting in identical characteristics.
Large donut-shaped loom weight 	*Large donut-shaped loom weight* The weight was made from a coiled piece of clay that was too long to be hold in the hand or wound around the finger; the weight was shaped on a horizontal surface creating one flat side. Characteristics: width over 9 cm. Perforated with a stick and the perforation diameter is usually 1-2 cm.
Spherical loom weight 	*Spherical (ball-shaped) loom weight* Characteristics: Width and height vary by no more than 1 cm. Spherical/ Ball-shaped loom weights are over 5 cm in diameter. Perforation diameter is over 1 cm.
Wheel-shaped loom weight 	*Wheel-shaped loom weight* Characteristics: Width more than 1 cm wider than height, ends flat. Usually over 9 cm in diameter. Perforation diameter over 1 cm.
Cylindrical loom weight 	*Cylindrical loom weight* Characteristics: Width and height vary no more than 1 cm, ends flat. Perforation diameter is over 1 cm.

Differences in shape due to perforation
The perforation in loom weights is realized in different ways. When using a stick to make the hole, this can create a loom weight with a truncated top. Pulling the stick out of the wet weight creates the truncation; the truncated top does not point to a different type of loom weight, but merely shows that a stick was used to perforate the loom weight. This phenomenon is often found in wheel-shaped loom weights and in large donut-shaped weights.

The results of the experiment and the basic typology were used as a framework to study the loom weights of Tell Deir Alla phase IX, Tell Mazar, Khirbet al-Mudayna and Tell er-Rumeith (Chapters 6-9), which resulted in a new typology of perforated clay loom weights from Iron Age Transjordan proposed in Chapter 10. From the experiment, the following basic typology could be designed.

Chapter 5 Loom weights in the Levant: an overview

5.1 Introduction

The function of loom weights was to stretch the warp threads on a vertical loom. The warp threads were suspended from the starting border that was attached to the top beam.
Loom weights were tied to the warp threads. In the case of perforated loom weights, the threads were not tied directly to the warp threads but a looped cord was threaded through the perforation connecting a number of warp threads to the loom weight. The loom weights supplied tension and kept the warp threads parallel. The tension could easily be adjusted by adding more weights or by retying the warp threads, and therefore the warp-weighted loom is less dependent on precise warping than either the ground or vertical loom (Friend 1998:4, Hoffmann 1974:42). Weight variation among loom weights within the same assemblage is a common phenomenon (see Chapters 6-9).

The loom weight is an interesting artefact because it is often the only preserved remnant of a loom used in antiquity. During excavations loom weights are easy to recognize if they are made of metal, stone or ceramics. Within burnt layers, unfired clay loom weights can be accidentally fired and thus well preserved. But it is difficult to recognize and securely excavate unfired *raw* clay loom weights. The two main problems are:
1. Unfired loom weights disintegrate when they get wet.
2. When excavating a mudbrick site, the clay of the loom weights resembles the matrix they were found in.
However, with an open mind and skilled hands it is possible to find and excavate the weights of a warp-weighted loom.

Fig. 5.1 Excavating the loom weights in BE9 at Tell Deir Alla 1998. Leaving the weights in their context while digging made it possible to reconstruct the loom to which they once belonged.

In the following chapter, the differences in clay loom weights from the Levant will be discussed. Clay loom weights vary in type and their main division is whether they are perforated or not. In

the Bronze Ages, loom weights tended to be made of fired clay and there is a difference in shape and weight between loom weights from northern and southern Levantine sites.
The situation in the Southern Levant shows the same tendency on both sides of the river Jordan: the Iron Age yields more loom weights than the preceding periods, the loom weights are made of unfired clay and the relative weight of the loom weights increases. In the Iron Age II period, however, the material from Transjordan appears to reveal its own regional development that differs from the situation in Cisjordan.

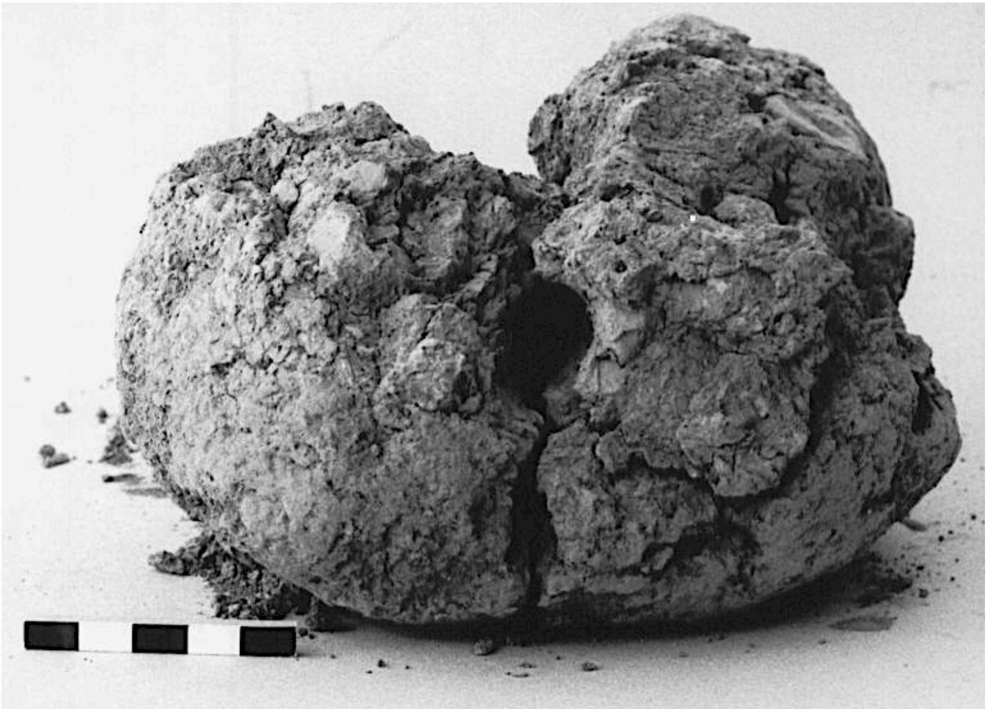


Fig. 5.2. Unfired loom weight showing how brittle and damaged some of them were when excavated. These 'ugly lumps of clay' are also part of the chain that tells the story of the ancient warp-weighted loom.

5.2 Types of loom weights

Examination of loom weights from a number of sites has revealed regional, typological and chronological variations (Vogelsang-Eastwood 1989:60; Shamir 1996:139-140; Friend 1998:8). Typologically the main division in loom weights is whether they are perforated or not.

Non-perforated loom weights
Loom weights without a perforation are often cylindrical in shape and are known as spools, reels, dumbbell-shaped or cigar-shaped loom weights. Their function as loom weights on the warp-weighted loom is not completely clear, (Gleba 2008:140-150) because there are no illustrations of spools to aid understanding of their function. Most scholars agree that they were used on some kind of loom.
Because non-perforated loom weights, and especially the unfired spool-shaped objects, have not always been recognized as loom weights, their presence is an unknown part of loom weight history. The distribution of non-perforated loom weights differs in some respects from that of the perforated ones, as described in Chapter 2. Here a short overview is given of the path of non-perforated loom weights on their way to the Levant.
The earliest non-perforated loom weights are known from Bulgarian Neolithic sites and are comparable with spool-shaped loom weights excavated at Kastanas[62] in Macedonia (Barber 1991:98; Hochstetter 1987:90-91,pl.22.1-3,36.17-18). Non-perforated spool-shaped loom weights were also excavated in Mycenae and Tiryns in levels dated to the Late Helladic IIIC (Iron Age I)

[62] Kastanas Layer 13 (c. 1190 BC).

(Rahmsdorf 2003: 397,400-402; 2008:59-73), and in Pylos and Troy (Blegen 1958:152,fig.256). On Cyprus spool-shaped loom weights have been found at Maa Palaeokastro (Karageorghis and Demas 1988:222) and Kition (Karageorghis and Demas 1985: 133,153,166 pls.201 and 229). At Maa Palaeokastro some small spool-shaped loom weights made of fine yellow clay were found in association with fine burnished pottery, dated to the 12th century BC.
In Anatolia, spool-shaped loom weights have been found at Çatal Hüyük (Haines 1971:pl.16B) and in the Late Bronze Age layers of Alishar Hüyük, Tarsus and Tille Hüyük (Cecchini 200:217). The recently published spools from Tell Tayinat on the plain of Antioch are dated to Early Iron Age I (1200-900 BC) (Harrison 2009:183). At Tell Tayinat, the cylindrical non-perforated loom weights become less frequent towards the end of Iron Age I, but Harrison's article does not clarify whether they were replaced by perforated loom weights (Harrison 2009:183).

Perforated loom weights
Perforated loom weights can be divided into two main groups depending on the location of the perforation: 1. Horizontally perforated or pendant-shaped weights. These weights are perforated in the upper half of the weight, which makes the weights hang like a pendant. 2. Centrally perforated loom weights, pierced in the middle of the weight.

- Horizontally perforated loom weights:
The conical loom weight; all kinds of pyramidal weights; the dome-shaped or beehive-shaped loom weight; the ovoid type which is an egg-shaped weight; the oblong loom weight which is a high cylindrical weight.

- Centrally perforated loom weights:
The donut-shaped loom weight, (and the biconical weight); the spherical or ball-shaped loom weight; the cylindrical or drum-shaped loom weight; the wheel-shaped loom weight.

The function of weight and type in loom weights
Weight is one of the most important functional features of a loom weight. Barber 1991:52) states that the weight of a loom weight is often more than 150 g, which equals the weight of the heaviest spindle whorl. However, because they can also be lighter than 150g (in the Hellenistic period their weight is usually under 50 g, see Chapter 7.3) this is not an absolute criterion to discern between the two. To distinguish spindle whorls from small loom weights, it is important to keep in mind that spindle whorls have to be smooth and made of a hard and durable material (never made of unfired clay), and of even more importance they have to be balanced and thus in most cases they will be pierced centrally.

Weight variation among loom weights within the same assemblage is a common phenomenon. However, weight variations of more than 200 g between the weights within a set used on a warp-weighted loom can create a distortion in the textile (Shamir 1996:143). The reason for this variation within one assemblage is not known. Possibly the number of threads tied to each weight was not always the same, and it was thus not necessary to make each loom weight identical in weight. A larger number of warp threads might have been tied through a heavier loom weight while a lighter one could bear fewer threads (Andersson Strand 2010:18; Shamir 1996:143; Broudy 1979:26; Hoffmann 1974:314). The weight of loom weights is also dependent on the kind of material used to weave, bast fibres need heavier weights than wool, and thus the weight of the loom weights could indicate what kind of textiles were produced (discussed in Chapter 10).

Not only the weight, but also the thickness[63] of the loom weights is of importance for the weaving process because this spaces the weights on the loom. Experiments in the Copenhagen (TTTC) programme revealed that the thickness of a loom weight controls how closely threads of a

[63] The term *thickness* was introduced by Andersson Strand (2010); it is the diameter of pendant loom weights and the height of central perforated loom weights.

particular diameter will be spaced in the fabric, leading to the following conclusions: if an open fabric is required with thick yarn, heavy and thick loom weights will be necessary. And if a coarse, dense fabric is desired with thick yarn, heavy but thin loom weights will be chosen. On the other hand, when an open fabric made of thin threads is wanted, light and thick loom weights are required. And if a dense fabric made of thin yarn is preferred, then many threads per cm are required and therefore light and thin loom weights will be chosen (Andersson Strand 2010:18).

Material

Metal loom weights have not been found in the Levant. Stone loom weights have been used, and were, for instance, present in the Early Bronze Age layers of Tell Abu al-Kharaz, which site yielded eight stone loom weights (Fischer 2008:109, fig. 314). However, most loom weights from the Levant were made of fired or unfired clay. In the Bronze Age loom weights were usually made of fired clay (ceramics) (Friend 1998:8), while in the Iron Age they were made of local unfired (or poorly fired) clay.

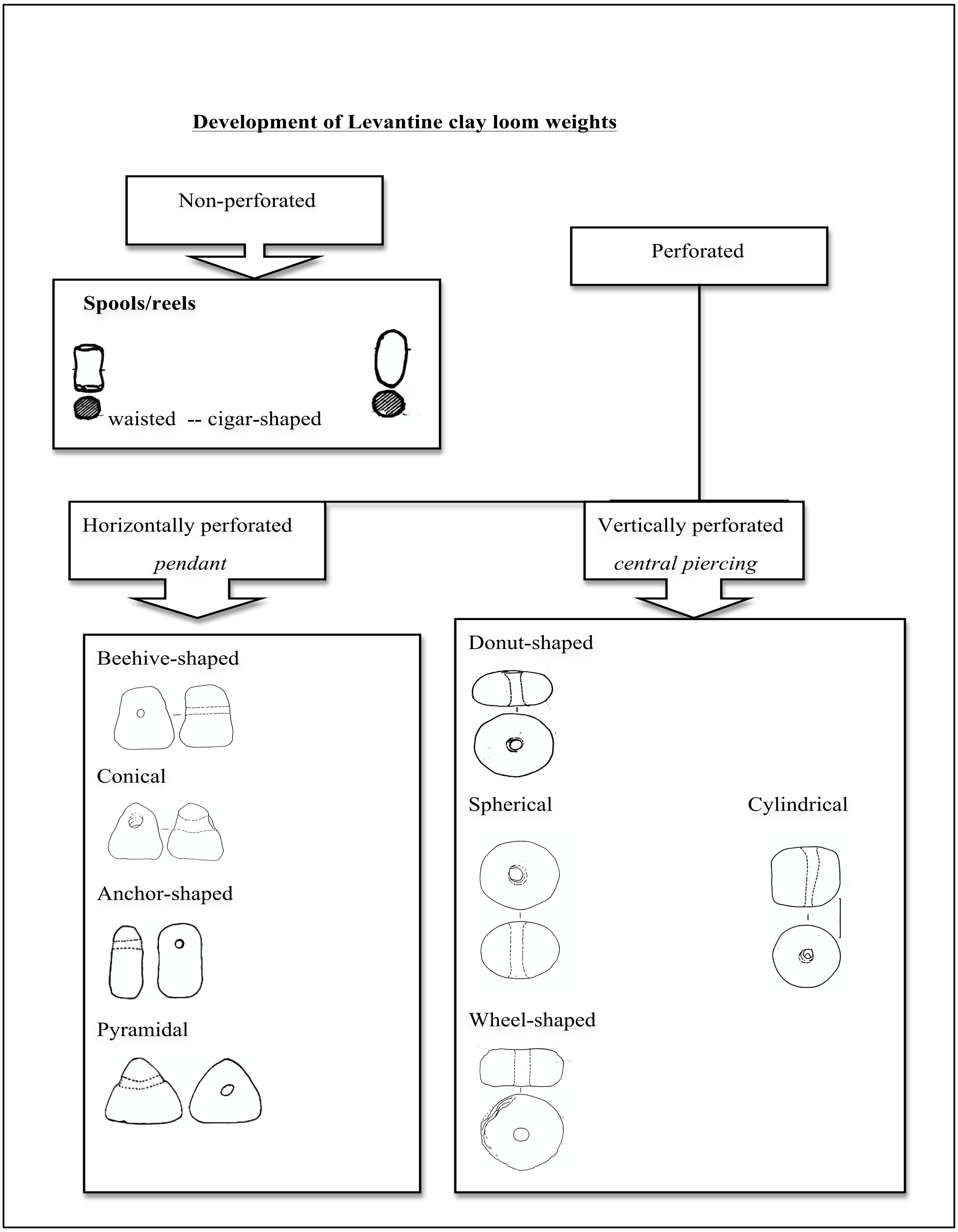


Fig. 5.3. Schematic overview showing the development of Levantine clay loom weights.

5.3 Loom weights in the Northern Levant

There is a difference in the shape and chronology of loom weights from the northern Levantine sites and those in the south. Until recently no loom weights had been published from Syria. The lack of published loom weights from Syria caused Elisabeth Barber to state that there was no trace of these weights in Syria, the area between Anatolia and Palestine (1991:300 and 302). However, it seems that in Syria these artefacts have been excavated, but have only recently been published. The finds at Tell Afis (Cecchini 2000), Tell Mefrisheh (Besana 2010) and Tell Mardikh (Peyronel 2007) can be regarded as the missing links between the loom weights from Anatolia and those of the Southern Levant.

The advance of the warp-weighted loom resulted from the transfer of material culture from the Aegean, possibly Cyprus, via the coast to Anatolia and northern Syria into the Levant. Non-perforated spool-shaped loom weights were being used in northern Syria during the Middle and Late Bronze Ages and in sites in inner Syria from the start of the Iron Age (Cecchini 2000:217). Peyronel, who published the loom weights of Tell Mardikh (Ebla), reported only two bell-shaped pierced loom weights from the Middle Bronze IB /IIA levels (c. 1900-1750 BC), weighing 303 and 322 g. The Late Bronze Age levels did not yield any loom weights (Peyronel 2007:34). At Qatna (Tell Mishrifeh), spool-shaped loom weights have been found in association with other textile-related tools in the artisanal quarter of the *Eastern Palace*, dated to the Middle Bronze Age (Besana 2010).

Non-perforated loom weights from Syria

Non-perforated loom weights have been excavated at Tell Afis, Tell Mastuma, Hama, Tell Masin (near Hama), Tell Nebi Mend, Tell Ahmar, Taba el Akrad and in the Neo-Hittite site of Malatya (Cecchini 2000:212-213). Unfired spool-shaped loom weights have been found in the Iron Age I layers of Tell Tweini (Vansteenhuyse 2010), while in Iron Age II the weights are of the same type, but fired. In Qatna (Tell Mishrifeh), the Iron Age II levels yielded a large number of reel-shaped loom weights together with some pierced conical and bell-shaped loom weights (Besana 2010). At Tell Afis, reel-shaped loom weights continued to be used In Iron Age II, but to a lesser degree than in the earlier period, and they were combined with perforated loom weights. A similar process can be seen at Tell Ahmar, Tell Nebi Mend, Tell Masin (near Hama) and Tabara el-Akrad (level I). At Tell Afis (Cecchini 2000:117,119), where unfired clay loom weights are found alongside fired examples, and in the Iron Age II period, perforated loom weights tend to be fired. Cecchini speaks of a transitional phase (Cecchini 2000:219). This is a very interesting phenomenon, which resembles the situation on Cyprus where at Kition and Enkomi the spool-shaped loom weights occur together with perforated loom weights (Karageorghis and Demas 1985:133,153, 166). From Tell Mastuma, Cecchini reports 25 storage jar rims smoothed so as to have a cylindrical shape, that were found together with perforated pierced loom weights and 25 cylindrical objects (Cecchini 2000:219 and 223). In Syria, pierced spheroid loom weights replaced the spools/reel-shaped loom weights between the end of the eighth and the start of the seventh century BC (Cecchini 200; Besana 2010).

Perforated loom weights from Syria

At the beginning of the Iron Age the situation changes and perforated loom weights start to appear, used in combination with non-perforated loom weights within the same loom. The reels/spools are extremely fragile, and their weights range between 100 to 500 g. Later in Iron Age II, the spool or reel-shaped loom weights gradually disappear and only perforated loom weights are used. Cecchini (2000:216-223) gives convincing examples from different places in Syria, especially from Tell Afis, whose loom weights she has studied. At Tell Afis unfired reels/spools have been found in Iron Age I. Iron Age II Tell Afis yielded unfired and fired clay reels/spools alongside reworked storage jar rims and pierced, backed or partially backed cylindrical loom weights. Riccardo Besana, working on the loom weights of Tell Mishrifeh (Qatna), describes the same pattern: spool-shaped loom weights occur in Iron Age II levels together with perforated weights, while in Iron Age III perforated loom weights form the predominant type (2010).

Peyronel (2007) published 981 loom weights from the late Iron Age phases of Tell Mardikh (Ebla). These weights are manufactured in local clay and are unbaked or only slightly fired. 84.6% are spherical and donut-shaped, and their weights range from 63 to 512 g. A group of Persian loom weights was also recovered. These loom weights are very light, between 27 and 63 g, and their shapes are square, pyramidal and spherical.

Loom weights from Lebanon
Hardly any loom weights have been published from Lebanon. From Sarepta, Iron Age cylindrical and donut-shaped loom weights are mentioned (Beyhum 2001). From Beirut, Curvers and Stuart (1995) recorded some Hellenistic ceramic loom weights with two perforations.

Perforated loom weights in the Northern Levant
The Bronze Ages in the Northern Levant yielded no pierced loom weights, and apparently only non-perforated loom weights were used in this period. Perforated loom weights are only found in the Iron Ages. The perforated loom weights from Hama are fired. They are mainly small and cylindrical but donut and anchor-shaped loom weights have also been reported (Riis and Buhl 1990:729-731, fig. 96).
In 2000 Cecchini published the Iron Age loom weights of Tell Afis in northern Syria. The Iron Age II levels yielded both non-perforated and perforated loom weights. The Iron Age III levels yielded only perforated loom weights. The loom weights from Tell Afis are spherical, conical, donut and wheel-shaped, and their weights range between 31.4 and 690 g. They are made of fired clay (Cecchini 2000:215 fig. 2, 218 fig. 3, 221 fig. 4, 224 fig. 5, 231-233). The loom weights were found together with six bone spatulas (Cecchini 2000:227, 333 fig. 6). From Tell Nebi Mend, perforated reels/spools are found together with perforated oval loom weights (Cecchini 2000: 219). At Tell Mastuma non-perforated cylindrical loom weights were found alongside reworked storage jar rims (Cecchini 2000: 219), while from Sarepta only pierced cylindrical and donut-shaped loom weights have been reported (Beyhum 2001). At Tell Mardikh (Ebla), a sample of 981 loom weights points to widespread use of the warp-weighted loom during the late Iron Age and Persian Period in northern Syria. The weights are manufactured in local clay tempered with sand or chaff, usually unfired or only slightly fired. The conical and pyramidal weights are all fired. A small group of spherical/biconical weights are decorated with rows of punctured or combed lines (Peyronel 2007:30, fig. 5.7). About 250 loom weights have been excavated from the Iron Age II and III levels of Tell Mishrifeh (Qatna), together with a corpus of spinning and weaving tools. The Iron Age II layers yielded a great number of reel-shaped loom weights together with some conical and bell-shaped ones, while in the following Iron Age III the donut-shaped loom weight is predominant. The loom weights from Qatna were mainly discovered in situ, associated with bone spatulas, spindle whorls and plastered installations (Besana 2010).

5.4 Loom weights in the Southern Levant: Bronze Ages and Iron I period

The development of loom weights differs from the situation in the Northern Levant because in the Bronze Ages only perforated loom weights have been found, and from this period non-perforated loom weights have not been found on either side of the river Jordan.
From Iron Age I onwards a remarkable difference appears between the regions in Cisjordan; along the coastal plain (in the Philistine sites) the influence of the Aegean becomes visible in the use of non-perforated loom weights, whilst the sites in the hill country revealed only perforated loom weights. No loom weights have been published from Transjordan Iron Age I, but in the Iron Age IIB levels of Deir Alla one complete non-perforated loom weight has been found together with some fragments of weights, possibly of the same shape without a perforation. They were found with a group of perforated loom weights dated to c. 800 BC. This find raises the question of whether non-perforated loom weights tend to be missed in excavations because they are not recognized as loom weights, or whether they were never used in this part of the Levant (Boertien 2009b). When completing this research (spring 2013) I heard about a very surprising and

interesting find at Tell Abu al-Kharaz, which might confirm my idea about not recognized or missing non-perforated loom weights. Peter Fischer found a set of non-perforated reel-shaped loom weights at Tell Abu al-Kharaz in the Jordan Valley (Fisher forthcoming 2013). Because no further information is yet available I will come back to this subject in the future and publish an additional article on the non-perforated loom weights from Transjordan.

Bronze Age

On both sides of the river Jordan the evaluation of loom weight types follows comparable patterns.

Until recently there was no clear evidence for the existence of loom weights in the Southern Levant prior to the Middle Bronze Age, although Glenda Friend (1998:13-14) concluded that the warp-weighted loom was already used at Tell Ta'anach in the Early Bronze Age. The perforated clay loom weights from Early Bronze Age levels at Tell Ta'anach are unconvincing because the stratigraphical information is not clear and because only three loom weights were found (Boertien 2004). Early Bronze Age finds from Tell Abu al-Kharaz, however, shed new light on the situation. Peter Fischer found the remnants of two burnt wooden looms in the Early Bronze Age layers together with stone loom weights (2008). These finds make it necessary to reconsider the possibility of the use of the warp-weighted loom in the Southern Levant in the Early Bronze Age.

Tell Abu al-Kharaz

Tell Abu al-Kharaz is situated in the Jordan Valley. It was a walled city with domestic structures. The site was excavated and published by Peter Fischer (2006, 2008). A basalt spindle whorl of 38 g was excavated in the Early Bronze IB layers, with the thread still wound around the carbonized stick (Fischer 2008:354, fig. 315). The other spindle whorls range in weight from 34 to 66 g. A storage jar from this period showed the impression of a piece of cloth. The fabric is made in a plain tabby weave with a thread count of 19-25x13 threads per square cm. In a roofed room, measuring 3.6x3.3 m, burnt remains of two wooden looms were found. One of them was found together with eight basalt loom weights. This loom was being prepared for weaving prior to the catastrophe that destroyed the house. The loom weights were found in a row, and the author concludes that they were perhaps aligned by means of a wooden stick. The loom weights are light, their weight ranging from 21 to 87 g. The loom weights were found together with storage jars, a copper awl and a copper knife, some bone weaving tools and large amounts of carbonized grain (Fischer 2006:193, 141; 2008:49, 381, figs. 35 and 37). Forty-eight objects have been classified as spindle whorls/loom weights, with diameters varying from 3.2 to 5.1 cm; the diameter of the perforations ranges from 0.9 to 1.5 cm. Unfinished examples show that there was on-site production of stone spindle whorls and loom weights. The criterion to distinguish between loom weights and spindle whorls, according to Fischer, is the position of the perforation. The balanced perforated objects are called spindle whorls, with weights ranging between 20-60 g. The items that are unbalanced when rotating are called loom weights; their weight is up to roughly 90 g (Fischer 2008:353). The identification of these objects as loom weights or spindle whorls is an interesting problem. Unfortunately no references are available; only once more such items are found and published will it be possible to confirm the identification.

Tell Ta'anach

Three perforated ceramic loom weights dating to Early Bronze Age III have been found at Tell Ta'anach. Their weights are 297, 230 and 219 g. Two loom weights are conical and one is cylindrical. Friend mentions loom weights from the Early Bronze Age III layers of Tell Halif (Tell el Khewelfet) of similar type (unpublished thesis 1996:55). She suggests that further research needs to be done on the stratigraphy of Tell Ta'anach (Friend 1998:14) to confirm the dating of the Early Bronze Age loom weights.

Middle Bronze Age and Late Bronze Age in Transjordan

In Jordan, no loom weight data have been published from the Middle Bronze Age and Iron Age I levels. Recently, Late Bronze Age loom weights have been found at Tell Abu al-Kharaz in the

Jordan Valley. These weights are small non-perforated reel-shaped loom weights (Fisher forthcoming 2013). Tell Deir Alla yielded Late Bronze Age loom weights (personal observation 1999), but they are not yet published.

Middle Bronze Age (Cisjordan)
Seventy-six pierced loom weights have been excavated at Tell Ta'anach (Friend 1998:14-36); Beth Shean yielded three unfired Middle Bronze Age pierced loom weights, and seven perforated fired clay loom weights (Yahalom-Mack 2007:666-669, fig. 12.5, photo 12.5). Jericho Middle Bronze II yielded perforated loom weights, some of which showed vertical grooves created by the rubbing of a single thread inside the perforation (Wheeler 1982:623), Megiddo stratum IX (Loud 1948:pl.170).Two conical fired loom weights (Dever 1974:pl.40:2-3) and a fired cylindrical loom weight have been recorded from Tel Gezer (Dever, Lance and Wright 1970:pl.37.7). A very special loom weight was found in Tel Nami. From the Middle Bronze Age layers, Marcus and Artzy report a conical loom weight with a seal impression (Marcus and Artzy 1995:136-149).

Late Bronze Age (Cisjordan)
It has been suggested that during the Late Bronze Age no loom weights have been found because the Mesopotamian/Egyptian two-beam loom was used during this period (Yasur Landau 2009; Mazar 2009 and Yahalom-Mack 2007). Cecchini suggests that the number of loom weights decreases notably during the Late Bronze Age (Cecchini 2000:214). But from the following finds an alternative conclusion has to be drawn. Four pierced loom weights have been found at Tell Ta'anach (Friend 1998), and in Megiddo stratum IX pierced loom weights have also been found (Lass 1994:33). Macalister found a small group of well-fired pierced loom weights at Tell Gezer, but most of the loom weights from Late Bronze Age Tell Gezer are unfired donut-shaped and spherical loom weights (Macalister 1912:73-74 fig. 268d). Albright reported the same type of donut-shaped and spherical loom weights from Tell Beit Mirsim (Albright 1938:pl.45:9-16). Pierced loom weights were also reported from Tell Abu Hawam (Hamilton 1935:324-327, pl. XXXI). It can be concluded that Late Bronze Age loom weights have been found in Israel as already mentioned by Shamir (1996).

Iron I period
No Iron Age I loom weights data have (yet) been published from Transjordan.[64] In Cisjordan in Iron Age I, both non-perforated loom weights and perforated loom weights have been found.

Non-perforated loom weights in the Southern Levant
Sites in the coastal plain show a marked development in the use of non-perforated spools/reels, compared to the situations in Anatolia, Syria and Cyprus. The non-perforated loom weights have been associated with Philistine sites (Shamir 1996:140).
In Cisjordan, cylindrical non-perforated loom weights are reported from the Iron Age I levels of Ashdod Stratum XIIIA, associated with pottery of Mycenaean 3C1b type (Dothan and Porath 1993:64, fig. 24:3-5, pl.39:4). *Reel* or *spool-shaped* loom weights have also been excavated at Ashkelon (Lass 1994), Tel Miqne/Ekron (Dothan and Gitin 1990:31; Shamir 1991, Stager 1995:346), Megiddo (Loud 1948:pl.170:26), Qubur al Walayidah and, on the shores of Nahal Besor, in the Iron Age I layer (Lehmann and Niemann 2007; Maher 2010:11).
The Aegean, or more precisely Cypriot origin, of spool-shaped loom weights may certainly be taken into consideration in relation to Palestine (Cecchini 2000:216). The coastal plain was influenced by the Minoan culture; these influences will also be visible in textile production. The idea that the typical, relatively small, non-perforated clay spool-shaped loom weights used in the Philistine area along the coast of Palestine during Iron Age I are such remnants is absolutely valid. The theory that the non-perforated loom weights were brought into the southern Levant from the

[64] There is a small chance that non-perforated loom weights have not been recognized as loom weights and thus will not be found in excavation reports.

Aegean (Cyprus) by the Philistines (Yasur-Landau 2007) is correct, but it is incorrect to call these loom weights *Philistine Loom Weights.* The terminology raises questions firstly because the loom weights from the Philistine site of Tel Qasile stratum XII are of the perforated type (see below), and secondly because Beth Shean, outside Philistine territory, yielded 19 'dumbbell shaped' non-perforated loom weights from level VII (James and McGovern 1993:fig. 115:4-7; Yahalom-Mack 2007:666, 669, note 2). Iron Age non-perforated loom weights have also been found in 7th-century levels at Ashkelon (Master 2011:494-501). The term 'Philistine loom weight' has an ethnical connotation that has not yet been demonstrated. The name Philistine loom weights, therefore, should be replaced by a neutral and non-ethnic name such as 'non-perforated loom weight' or 'spool/reel-shaped loom weight'.

The study of non-perforated loom weights from the southern Levant must concentrate on their function because it is not yet clear whether these weights were used on a warp-weighted loom or on some other kind of loom. The circumstances and the position in which they were found suggest they were associated with textile crafts (Barber 1991:97-99). Functional analyses of loom weights are mainly based on their weight. The loom weights from the Aegean and from Cyprus are much smaller than those from Syria, which might point to a difference in use.
Gleba (2008:140-141, fig. 98) and Raeder Knudsen (2002:228-229) have convincingly demonstrated that small spools were used together with tablets and a spacer to produce tablet woven (garment) borders on the Verucchio textiles; their weight supports such an interpretation. These weights range between 8 and 55 g, with most being 20-30 g. Alternatively, spools could have been used for other types of weaving, resulting in narrow strips of patterned textiles (Gleba 2008:141).
To distinguish between spools used as loom weights on the warp-weighted loom and spools used on other kinds of looms, it is important to find distinctive differences. There are two groups of spool-shaped loom weights. The following characteristics might help to distinguish the different kinds of spools.

1. Small spools (comparable to the spools described by Gleba 2008:140-141, reconstruction fig. 98). They are made of terracotta and range in length between 3 and 10 cm; their weight is about 20-30 g. This type was used in combination with tablet weaving or some other kind of small loom.

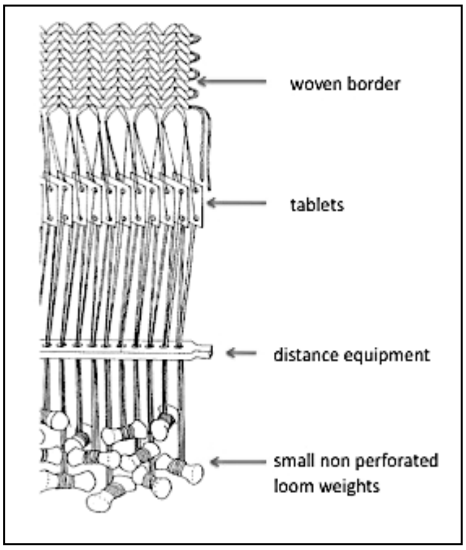


Fig. 5.4. Tablet weaving using small spools as weights, estimated by Reader Knudsen 2002:228-229 (after Gleba 2008:140 fig. 98).

2. Large spools (comparable to those described by Cecchini 2000:219, reconstruction 230:fig. 7). Measuring 7-12 cm in length, heavier, between 100 and 450/500 g, they were made of unfired clay or ceramics. They were used on the warp-weighted loom.

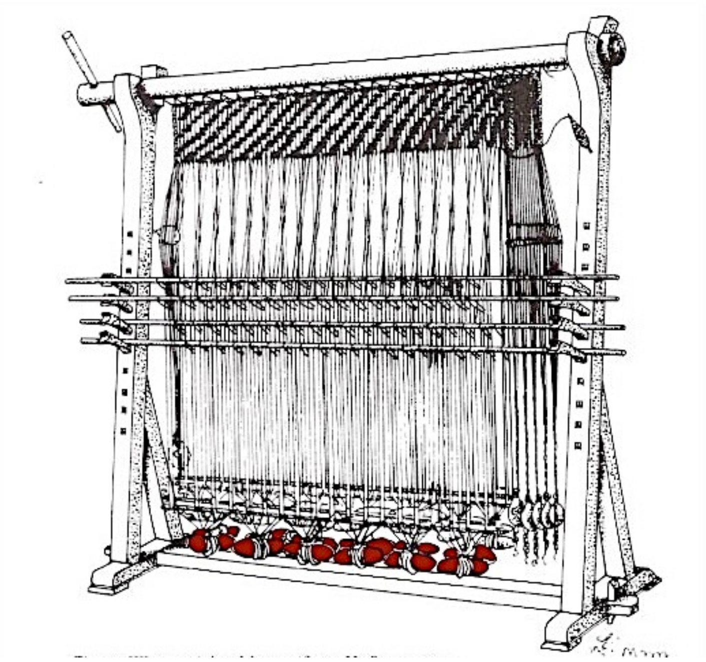


Fig. 5.5. Reconstruction of a warp-weighted loom using spools/reels (after Schlabov 1976:13).

In the southern Levant, additional research may clarify whether non-perforated weights were used in tablet weaving or on the warp-weighted loom. To distinguish between the different types, a systematic typology is needed. Margarita Gleba (2008:143-145, fig. 99) published a typology of non-perforated spools from pre-Roman Italy and this systematic description and representation of spools is suitable for use in the archaeology of the Levant.

In order to distinguish between the different sets of weights, it is necessary to record the finds systematically and stratigraphically, to know the square and locus of all the excavated loom weights. Numbers of weights within sets of excavated loom weights should be counted. If spool-shaped loom weights are found in situ, forming rows of more than 10 weights, it points to their use as weights on a warp-weighted loom. But if these weights are found in smaller numbers they may be either loom weights for a warp-weighted loom or weights for other kinds of loom.

The weight of Levantine spools should be compared to the weight of perforated loom weights, to compare their weight ranges to objects definitely identified as weights used on the warp-weighted loom. The fact that loom weights similar in type and weight were used to produce similar kinds of textiles reveals interesting information about textile production alongside the Mediterranean Sea in Iron Age I. The coastal sites of Philistia and Aram, and coastal sites as well as inland sites in Anatolia, Greece and Cyprus, yielded small spool-shaped loom weights. Sites in inner Syria and Cisjordan yielded heavier spools or pierced loom weights of a heavier type. The use of identical kinds of loom weights does not point to ethnic similarities, but rather shows that the same kind of textile was produced. The conclusion is that in Iron Age I the same kind of textiles were produced alongside the Mediterranean Sea and in some sites in inner Anatolia, Greece and Cyprus, whilst other kinds of textile were produced in inner Syria and Cisjordan. To know more about these interesting similarities and differences, the research on loom weights must shift from purely typological research to research based on the functional aspects of loom weights.

Iron Age I perforated loom weights

Tel Qasile stratum XII yielded loom weights of the perforated type, donut-shaped and cylindrical (Mazar 1980:42-44; Mazar 1985:80 photo 85; Shamir 1994 b; Mazar 2007:326), according to Shamir (Shamir 1994a), showing close connections with the loom weights of the Late Bronze Age tradition.

5.5 Loom weights in the Southern Levant: Iron Age II period

From the Iron Age II period onward, loom weights are perforated and made of unfired clay, their weight increases and the predominant type is the donut-shaped loom weight. The finds listed below are not complete;[65] they are mentioned here because of their special interest for the loom weights of Transjordan.

Iron Age loom weights from Cisjordan

The publication of the loom weights and spindle whorls from Jerusalem, (the City of David excavations) by Shamir in 1996 is a benchmark in the study of loom weights. Shamir published a new typology for loom weights and spindle whorls. She also performed and published a weaving experiment with loom weights (Shamir 1996:135-167). The City of David excavations of Shiloh (1978-1985) yielded 186 loom weights and 73 spindle whorls from different areas. The spindle whorls were made of fired clay, limestone and basalt. The loom weights of unfired clay are of various shapes, 59.3% being donut-shaped. These 80 donut-shaped loom weights ranged in weight between 45.6 and 724.9 g. The other types of loom weights were four spherical loom weights, with a weight ranging between 337.8 and 805 g; five biconical loom weights, with weights between 22.8 and 82.9 g; two ovoid loom weights – one was complete and weighed 468 g, and ten amorphous loom weights, with weights ranging from 53 to 115 g (Shamir 1996). From the excavations of Kenyon in Jerusalem (1961-67), 128 loom weights have been recorded (Steiner 1990:122). The loom weights were found on a street next to a building, and had possibly fallen from the roof where the loom stood. The possibility that looms stood on roofs should be considered in interpretations of plans.

Tell Ta'anach yielded many loom weights dating from the Early Bonze Age until the Persian Period. The loom weights have been published by Glenda Friend (Friend 1998) in what is the first monograph on loom weights from the Southern Levant. Friend designed a chronological typology of loom weights based on the loom weights from Ta'anach and on the publication of Shamir from 1996. From the Iron Age layers of Tell Ta'anach, 92 loom weights have been registered, whilst six loom weights were from the Persian Period (and from mixed loci). From the same period, eight spatulas and seven spinning whorls, which were originally identified as loom weights, are published together with the loom weights. The published material and the typology designed by Friend were an important reference for my work on the loom weights from Transjordan.

For the study of loom weights textile remains are of great importance, and when fragments of textile are found together with loom weights it is a unique chance to study textile production. Two such collections have been found from the Iron Age II period. The 150 textile fragments from Kuntillet Ajrud and Kadesh Barnea (Tell Qudeirat) serve as a reference collection for the textiles published in this volume and will be used for the interpretation of finds associated with textile production such as loom weights and spindle whorls. The textiles found in Kuntillet Ajrud and Kadesh Barnea are unique, as they are the only textile remains published from the Iron Age period in Cisjordan.

Kuntillet Ajrud (Iron Age) in the Sinai yielded a hundred textile fragments and two groups of donut-shaped loom weights together with a bone point and piles of fibres and threads; spinning implements are missing. The average weight of the loom weights is 250 g, the average width 8.5 cm and the height is 4.5 cm (Sheffer and Tidhar 1991:10-12, fig. 26), see further Chapter 10.

[65] Orit Shamir (1996:140-142) drew up an overview of the distribution of loom weights in Cisjordan; she mentioned 46 Iron Age II sites in Israel that yielded loom weights. Additional information was published by Shamir and Baginski (1998 in Hebrew) and in Shamir 2006 and Yahalom –Mack 2006.

From *Kadesh Barnea* (Tell Qudeirat) in the northern Negev 50 textile fragments, one textile impression and 27 spindle whorls have been published. Small clusters of loom weights have been found. Together only 24 loom weights have been excavated and published; they are mainly spherical and donut-shaped, their weight ranging between 24.5 and 272.7 g. Eight loom weights show signs of wear (Shamir 2007:263). The following sites yielded additional information on loom weights, their shape, material and weight.

Beth Shean. (Tell el-Hosn). The Iron Age II strata yielded 12 spindle whorls and 115 unfired clay loom weights, together with 10 gypsum loom weights (Shamir 2006: 478-483; Yahalom-Mack 2006:468-478). Loom weights made of gypsum are an interesting phenomenon that will be further discussed in Chapter 6. *Tell el-Hama* yielded 161 loom weights and a spindle whorl with linen threads still wrapped around it (Shamir 1996:142; 2007:265). *Tell el-Oreme* (Tel Kinrot): two rooms within a single building yielded 102 loom weights and 26 fragments. The biconical and cylindrical loom weights range in weight from 172-498 g (Rabe 1996:100). *Tell el-Hesi*: from the Persian Period, 59 unfired loom weights have been reported (Tiede 1989:282). *Tell Ira*, an Iron Age stronghold in the Negev, yielded 130 loom weights. The majority of these are donut-shaped and spherical, weighing 100-200 g. Two heavy dome-shaped loom weights weighing 540 and 600 g have also been found (Ben Dov 1999: 445-449). Five spatulas and two needles have been registered (Beit Arieh 1999:450-451).
Persian Period sites in the Negev: Horvat Nimra yielded loom weights weighing between 21.4 and 249 g (Shamir 1997). Horvat Rogem yielded 41 biconical and donut-shaped loom weights with weights ranging between 21.5-179 g. From Horvat Mesura, four basalt loom weights have been registered together with several spatulas. Horvat Ha-Roa yielded 40 donut-shaped loom weights. A basalt spindle whorl was found at Horvat Mesura (Cohen and Cohen Amin 2004:79-188, figs. 107, 113, 115; Shamir 2004:19-28, figs.1, 3).

Iron Age loom weights from Transjordan
Finds associated with textile production from Transjordan are fewer than those known from the regions west of the River Jordan. In general these finds show the same tendency: the Iron Ages yield more loom weights than the preceding periods and donut-shaped loom weights are popular.
The material from Tell Deir Alla phase IX (Jordan Valley Iron Age IIB c. 800 BC) (Chapter 6), Tell Mazar (Jordan Valley Iron Age IIB, IIC, Persian and Hellenistic period) (Chapter 7), Tell er-Rumeith (northern hill country of Gilead, Iron Age IIA) (Chapter 9) and Khirbet al-Mudayna (Moab, Iron Age IIB-C) (Chapter 8) appears to reveal a Southern Levantine development in the use of the warp-weighted loom. Transjordan does show its own regional development, which differs from the situation in Cisjordan. The following overview is a brief summary of the situation in Transjordan (for details on the different sites see Chapters 6-9). Thus far, no loom weights have been published from Iron Age I.

Iron Age sites in Transjordan with loom weights listed from north to south
Tell er-Rumeith is situated in the eastern part of Northern Gilead in a plain in the hill country. Paul Lapp undertook the excavations in 1962 and 1967 (Lapp, P.W. 1963; 1968; 1969; 1975; Lapp, N. 1989; 1993; Barako 2008; 2009). Rumeith was a small rectangular fort measuring roughly 37 by 32 m. The houses inside the fort were alike in character and plan, consisting of two rooms and a staircase to the roof. The mound's main stratigraphy represented an occupation of about two centuries of Iron Age strata. The site yielded a small collection of artefacts used in textile production, 17 spindle whorls, 17 spatulas and 99 loom weights, indicating that textiles were produced for domestic use. The loom weights from Tell er-Rumeith are dated to Iron Age IIA. Thus far they are the earliest loom weights from Iron Age levels in Transjordan *(Tell er-Rumeith* by N. Lapp and T. Barako with a chapter on the loom weights by the author is forthcoming) see Chapter 9. In this study the material from Tell er-Rumeith has been used to test the idea that the geographical situation of a site, in combination with the weight of spindle whorls and the weight and type of loom weights, can indicate whether bast fibre or wool was used, see further Chapter 10.

Pella has been inhabited since the 10th century; in Iron Age IIB it was a fortified city. Some spheroid loom weights have been reported from domestic structures (McNicoll et al. 1992:90).

Tell Abu al-Kharaz
In the Iron Ages Tell Abu al-Kharaz was fortified. The houses and courtyards yielded pottery, such as imported white slipped ware and burnished ware, loom weights, spindle whorls and beads (Fischer 1991; 1993; 1994; 1996). Rinner (2009) published the Iron Age loom weights.

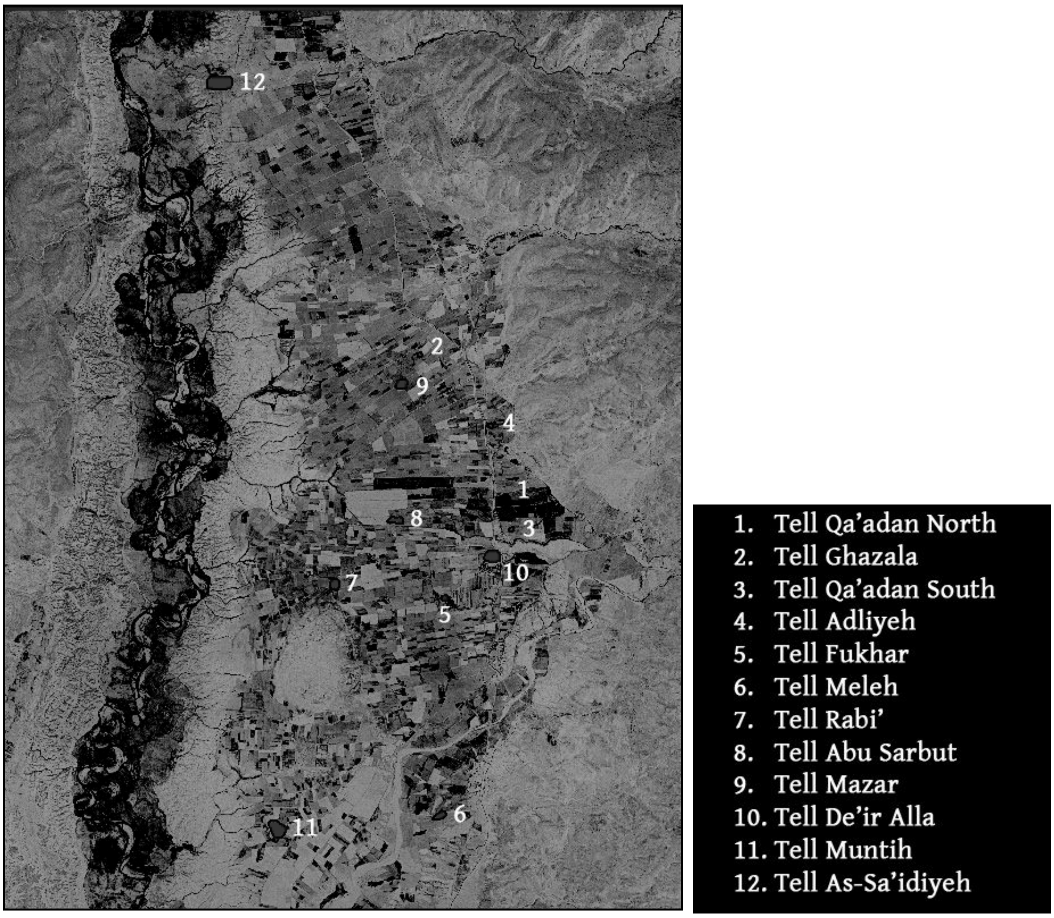


Fig. 5.6. Central Jordan Valley after the Mediterranean Landscape Dynamics Project (MEDLAND Arizona State University).

The eastern part of the Central Jordan Valley is bordered to the north by Wadi Rajib, to the east by the Transjordanian foothills, to the south by the Wadi Zerqa and to the west by the Jordan River. The region is usually regarded as the southernmost extension of the regularly settled part of the Jordan Valley (fig. 4.5). The Iron Age II Jordan Valley survey by Lucas Petit and Eva Kaptijn discovered 17 settlement mounds that yielded Iron Age material (Petit 2009). Tell Deir Alla can be seen as the type-site for the Jordan Valley. The work on the pottery and stratigraphy of this site (Franken 1969, 1982, 1992; Vilders 1992: Groot and Dik 2006, 2008, Groot 2010) can be regarded as the basis for a relative dating system for Transjordan.

Tell es-Saidiyeh was an unfortified village until the beginning of the 8th century, when it was enlarged and fortified. Stratum VII was a small village built at the end of the 9th century, and, at the beginning of the 8th century, the small village was enlarged to a town and fortified. The site was abandoned for a short period and in phase VI it was partially rebuilt, the street system reused and flimsy houses constructed. In phase V the town rose again as a well-planned city. Phase V was destroyed by fire in about 720 BC (Pritchard 1985; Tubb 1998; Weippert 1989). From the

burnt layer of phase V, dated to Iron Age IIB, 215 loom weights were excavated, 90% of which came from five different houses. Most of the loom weights are donut-shaped and a small number are conical. The loom weights average 7.9 cm in diameter and 5.7 cm in height with a central hole measuring 2.1 cm in diameter. In addition to the usual type, there are a few examples of a bag-shaped or teardrop weight, perforated horizontally near the top of the loom weight (Pritchard 1985:35). The weights of the loom weights from Tell es-Saidiyeh have not been registered. House 3 yielded 13 loom weights from the southwestern part of the room (not registered). House 5 yielded nine loom weights, four of which were found on the cobbled floor in the northern part of the house. House 6 yielded 79 loom weights, belonging to two different looms. The weights were found together with burnt wood, probably from the loom construction. House 14 yielded an unknown number of loom weights in a row next to a storage bin. House 15 yielded 42 loom weights. House 16 yielded 51 loom weights from three different places. In the southern part of the room 31 loom weights were found, five loom weights were found in the southwest corner of the same room. The other loom weights from this house have not been registered (Pritchard 1985:16-18, 35-38, figs. 73-75).
Burke states that the finds from Tell es-Saidiyeh provide a striking comparison with textile production at Gordion. Stratum V is contemporaneous with the Early Phrygian period at Gordion and the structures are very similar to that site's Terrace and Clay Cut buildings. The standardized plan and shared walls show that all of the units were planned and constructed at the same time. The buildings suggest a nucleated workshop aggregated within a single community (Burke 2010:166-167). Burke interprets the finds and the buildings of Tell es-Saidiyeh as specialized workshops; however, Pritchard interprets the structures as private dwellings with the furniture and artefacts appropriate to residences (Pritchard 1985:30). Six identical units were built in a line with their entrances facing a north-south street. The main rooms were pillared; the floors were partly paved. A small chamber was found behind the main room. The back wall of the chambers is shared by parallel set of units built directly behind the first set of six. The plan is a mirror image of the units across the street. The final conclusion of Burke is very interesting: 'The organized plan and consistent features of cooking facilities and textile equipment are highly reminiscent of the remains from Gordion.' (Burke 2010:166). This idea is fascinating and must be taken into account when interpreting the economic situation in Iron Age Transjordan.

Tell Mazar is situated in the central east Jordan Valley, 3 km east of the river Jordan between the Wadi Rajib-north and the river Zerqa. The University of Jordan conducted four seasons of excavations, from 1977 to 1981 directed by Khair Yassine (Yassine 1988; Van der Steen and Yassine 2012). The stratigraphy of Tell Mazar corresponds to that of Tell Deir Alla (Franken 1969; Franken 1992; Yassine 1988). Yassine states (1988:76-77) that the mound was found to contain occupations of different installations dating to the Late Bronze Age II, continuing into the Hellenistic period. His publication on Tell Mazar (Yassine1988:78-92) does not record material of the Late Bronze Ages, but there is unpublished material from the Late Bronze Age (areas P and Q: personal communication Van der Steen). On the lower mound (Tell Mazar mound A) an open court sanctuary was excavated, dated to the 10 th- 11th centuries BC (Iron Age I) (Yassine 1984:108-118, 1988:115-126 Yassine and van der Steen 2012:17-24), and a cemetery from the Iron Age II to the Persian period (Yassine 1984b). Neither the mound nor the cemetery yielded any loom weights. At Tell Mazar proper, about 550 loom weights have been excavated. It was possible to define 16 large groups, 73% of all the excavated loom weights, each group representing a more or less complete loom. Other objects associated with textile production have also been excavated, but it was not yet possible to get permission to study this material, see further Chapter 7.

Tell Deir Alla is located on the eastern part of the Jordan Valley, near the entrance to the Wadi Zerqa into the Jordan Valley. Since 1960, several excavations have been carried out on the tell, first directed by H.J. Franken (Franken 1969; 1992) and later by G. van der Kooij, both from the University of Leiden in the Netherlands, in cooperation with Yarmouk University represented by M. Ibrahim, later succeeded by Z. Kafafi (Van der Kooij and Ibrahim 1989). Phase IX, dated to c.

800 BC, Iron Age II B, was a period of intensive use, showing a densely built village begun as an architectural complex. In its final stage of existence the settlement suffered sudden destruction by earthquakes, accompanied by fires that broke out in many places (Van der Kooij 2002: 64). The debris from the fire has been relatively untouched by either erosion or by later inhabitants. As a result, therefore, objects belonging to this phase are provenanced securely and dated. The fire that destroyed Phase IX Deir Alla left many looms in their original positions. The unbaked clay weights were fired and found in situ preserved in the debris (Van der Kooij and Ibrahim 1989:80-82). Although the wooden frames of the looms have not survived, the 675 clay loom weights that were found indicate that the warp-weighted loom was in general use at Deir Alla. In addition to loom weights, different tools for textile production were found, like spindle whorls, bone pin beaters, needles, and even textile fibres have been excavated and analyzed (Vogelsang-Eastwood 1989; Boertien 2004), see further Chapter 6.

The survey and excavations by Lucas Petit and Eva Kaptijn in the Central Jordan Valley (Petit 2009; Kaptijn 2009) yielded information from three tells in the Central Jordan Valley. Some artefacts associated with textile production have been found at Tell Damiyah and Tell Ammata, but no such objects have been retrieved from Tell Adliyeh.

Tell Damiyah is located in the Zor directly south of the confluence of the rivers Zerqa and Jordan. It is considered the southernmost settlement with Iron Age occupation in the eastern Jordan Valley. The site was surveyed in 2004 and excavated in 2004 and 2005 (Petit 2009:103-152). The settlement had a mudbrick defensive system with several rooms abutted to its inner face. Small buildings, separated from the surrounding wall by a paved alley, occupied the summit. The construction suggests a fast, coordinated building programme, similar to Tell Deir Alla phase IX (Petit 2009:224). Some interesting objects associated with textile production have been excavated. Twenty-two loom weights have been found, most of them in pits from the Iron Age IIC/Persian Period. The loom weights are mainly horizontally perforated, conical or anchor-shaped, their height ranging from 5.5 to 10.4 cm; their width ranging between 3.5 and 7.7 cm; the holes range between 5 - 15 mm in diameter. The weight of the loom weights is not given. Two spindle whorls have been registered (Petit 2009:103-151).

Tell Ammata is situated on the north side of the Wadi Rajib, close to the slopes of the Transjordanian foothills and about 4 km north of Tell Deir Alla. Five brief soundings were conducted in 2005 and 2006. In the Iron Age the site was domestic in nature and surrounded by a wall. The tell yielded a few interesting finds associated with textile production, such as flax seeds, six pottery discs / flywheels and three loom weights (Petit 2009:33-63).

Tell al-Adliyeh is situated less than 1.5 km southeast of Tell Mazar and 2 km north of Tell Deir Alla. The site was surveyed in 2004 and excavated in 2004 and 2005. The discovery of flax seeds here is of great importance for the study of textile production but no objects associated with textile production were found (Petit 2009: 65-101).[66]

From two sites in the hill country of Ammon, artefacts related to textile production have been excavated and published.

Rabat Ammon, the principal city of Ammon, is located in the modern city of Amman. From the great temple, two loom weights with a double piercing have been excavated and registered (Koutsoukou, A. and M. Najjar 1997:144).

Tell Jawa is located directly south of Amman. Excavations began in 1989 under the direction of Randall Younker and Michèle Daviau. In 1992-1995, Michele Daviau of Wilfrid Laurier University, Waterloo, Canada, directed the project. The Iron Age settlement surrounded by casemate walls yielded many domestic objects, such as ground stone tools, and artefacts associated with storage, weighing and textile production. A total of 95 loom weights were recorded and documented, of which 81 are unfired donut-shaped or spherical loom weights, ranging in size from 6.50 to 10.50 cm in diameter, with a thickness of 4.10 to 8.50 cm. Their weight ranges between 200-1800 g. A selection of the best-preserved loom weights is listed in the

[66] In the near future I will study the artefacts associated with textile production from these excavations.

catalogue (Daviau 2002:191-200). The typology of Daviau is limited to four groups represented in the graph below.

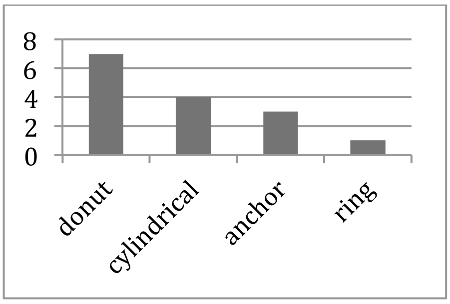


Fig 5.7. The catalogued loom weights of Tell Jawa.

Most of the loom weights (56%) belong to the group of 200-500 g, which can be regarded as the average loom weight in Iron Age II. Medium-sized loom weights, 600-850 g, form 24% of the total collection, whilst 15% of the loom weights are large, 900-1800 g. A likely (possible) conclusion is that at Jawa average to heavy textiles were produced. It is difficult to interpret the finds because no information is given in the publication about the find spots of the loom weights within the stratigraphic context.
Based on their weight, the loom weights are divided into five groups.

very small (200-300 g)	34%
small (350-550 g)	22%
medium (600-850 g)	24%
large (900-1300 g)	13%
very large (1350-1800 g)	2%

Table 5.1. Loom weights from Tell Jawa.

From Iron Age Moab, artefacts associated with textile production have been excavated from three different sites.

Khirbet al-Mudaybi is a small Iron Age II fort located on the eastern Kerak Plateau, which yielded 68 loom weights from a room belonging to the domestic quarters. The loom weights formed one loom, and they were found together with cooking utensils. The loom weights are made of local clay, and their shape is described as 'round' or 'cylindrical'. Their weights range between 70 and 437 g, their heights between 32 and 61 cm and the widths between 48 and 86 cm (Wade and Mattingly 2002:73-75). The photographs show donut-shaped and spherical loom weights. The loom weights seem to form four diagonal rows in the northwestern corner of square E5. The position of these rows could point to the production of a 2/2 twill weave.

Lehun is situated on the plain of Moab north of the Wadi Mujib. Denise Homès-Frederiq excavated a small village from Iron Age I. No loom weights have been found in the village, and only seven spindle whorls have been registered. Five were disc-shaped and made of pottery, one was made of stone and one could not be identified. In Iron Age II, this village was not inhabited, but a small fortress was situated to the south of the Iron Age I village. The rectangular fortress measuring 33-37x43 m is dated to Iron Age II (Homès-Frederiq 1997:67-78; Steiner forthcoming). No loom weights were found in the Iron Age fortification of Lehun.

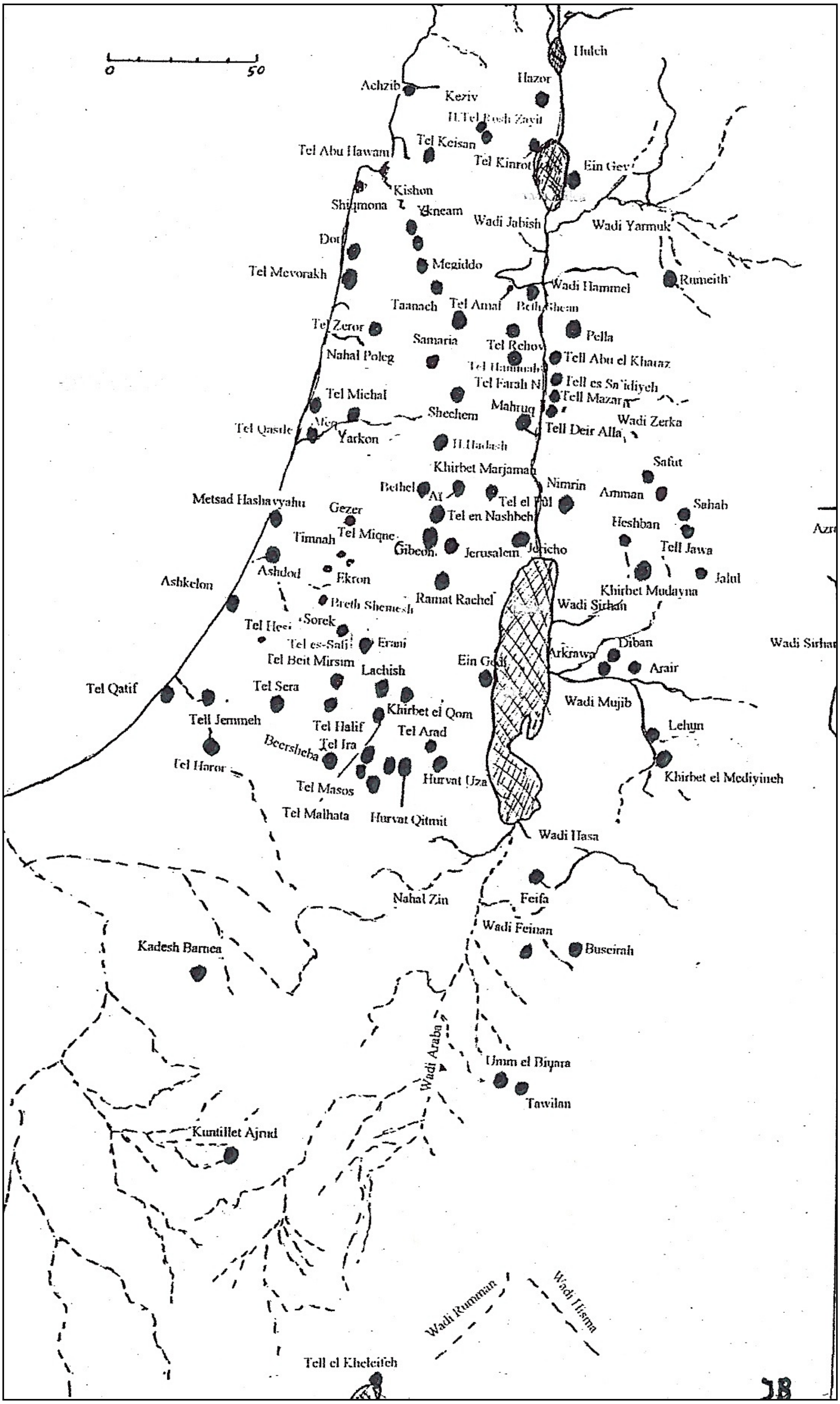
Khirbet al-Mudayna is a major Iron Age site in the Wadi ath-Thamad, on the northern border of ancient Moab. The excavation is part of the Wadi ath-Thamad Project of Wilfrid Laurier University, Waterloo, Canada, which started in 1995 under the direction of P.M. Michèle Daviau.The project was designed to investigate the distribution of Iron Age sites and to situate Khirbet al-Mudayna in its regional context (Daviau and Chadwick 2007; Daviau et al. 2006).

Khirbet al-Mudayna is a heavily fortified site with a casemate wall. A large six-chambered gate, comparable to gates found at Megiddo, Hazor and Gezer in Israel, gave entrance to the town (Daviau, Chadwick, and Steiner 2000). Adjoining a large open courtyard behind the gate stood a small building with benches alongside the walls, which could be identified as a temple (Daviau and Steiner 2000). The building of the walled settlement can provisionally be dated to the end of the 9th century BC, on the basis of several C^{14} dates. The site was attacked and burned down at the end of the 7th or in the 6th century BC. It may have functioned as a fortress guarding the eastern border of ancient Moab, or, as proposed by the excavator, as a centre for textile production, or both (Daviau et al. 2006). To investigate whether textile production is one of the main reasons for the existence of Khirbet al-Mudayna, a study of the material related to textile production was undertaken. Central to the research was the study of the 208 excavated loom weights.
Objects related to textile production such as spindle whorls, pins, spatulas and different materials probably related to dyeing were also investigated, see further Chapter 7.

From Iron Age Edom, only Tawilan has yielded loom weights and spatulas.
Tawilan is situated in southern Jordan; the Iron Age site was excavated by Crystal Bennett and published by Bennet and Bienkowski (1996). Bienkowski provides a comprehensive analysis of the stratigraphy, ceramics and other finds, paying particular attention to the cuneiform tablet and gold jewellery hoard (the first to be discovered in Jordan). Six small donut-shaped loom weights were excavated. Their weight was not registered (Bienkowski 1995:fig. 9.30). Thirty-two spatulas measuring 9.70-19.20 cm were excavated and registered (Bienkowski 1995:figs. 9, 10-11). The number of spatulas is very high when taking into account that only six loom weights have been found.

5.6 Conclusions

The above overview of loom weights and the discussion of their presence and distribution shows that the development of loom weights in Cisjordan and Transjordan synchronizes to some degree in Iron Age II.
On both sides of the river Jordan in the Iron II period, the numbers and the relative weight of loom weights increases, and loom weights are increasingly made of unfired local clay (Sheffer 1981:81; Shamir 1996:136; Friend 1998:9; Beith-Arieh 1999:445-446; Yahalom-Mack and Mazar 2006:476; Shamir 2007:263; this study, Chapters 6 and 8). The predominant group in this period is the donut-shaped loom weight (this study Chapters 6, 7, 8, 9). In the Persian Period loom weights change in shape; the predominant shapes are slightly pyramidal or oval, and heavy donut-shaped weights are not found any more (Shamir 1994b; Beith-Arieh 1999:446; Shamir 2004:19-20; this study Chapter 7). During the Hellenistic period the loom weights decrease in weight, the form changes to small pyramidal, cube-shaped or small spherical balls; these small and light loom weights are slightly fired (Shamir 1994a:272-274; Shamir 2004:26; this study Chapter 7).



Map. 5.1. Iron Age sites in the Southern Levant.

PART TWO

Research – Unravelling the finds

Chapter 6 Study of the excavated remains: Tell Deir Alla

6.1 Introduction

Tell Deir Alla is located in the eastern part of the Central Jordan Valley, where the river Zerqa enters the Jordan Valley (Pal. grid 208.178 EE I 321). The river Jordan flows 5 km to the west of the tell (map 1.1 and map 6.1). In the adjacent highlands the climate is temperate rainy and warm, while the Jordan Valley, being about 200 m below sea-level and situated in the rain shadow of the western highlands, the temperature is 8° C higher, which results in a warm steppe climate in the region north of the Wadi Zerqa, while to the south of this wadi the climate changes into a desert climate (Groot 2011:3). Eva Kaptijn has shown that the communities in the Zerqa triangle practiced some form of irrigation from the Iron Age onwards (Kaptijn 2009:322). The settlement mound of Deir Alla rises 28 meters above the surrounding valley and measures at its base 250 x 200 m. The first village (Middle Bronze Age II, ca.1700 BC) was built on a small natural hill of laminated Lisan marls. Long-term excavations at the site have revealed habitation until the Hellenistic period (circa 400 BC). An Islamic cemetery from the Mamluk period was found on top of the tell. From 1960 onwards excavations have been carried out on the tell, at first directed by H. J. Franken and from 1979 onwards by G. van der Kooij, both from Leiden University in the Netherlands. In 1976 the Department of Antiquities in Jordan (DoA) joined the project with M. Ibrahim as director. From 1982 onwards Yarmouk University (Irbid) joined the project under the direction of M. Ibrahim and Z. Kafafi. One of the goals was to provide a detailed micro-stratigraphic sequence of the tell, correlating with the social behavior of the inhabitants. Such a detailed investigation made it possible to deal with spatial analysis and the production, distribution and use of artefacts (Van der Kooij and Ibrahim 1989; Petit 1999:145; Petit 2009:22).

Phase IX [67]

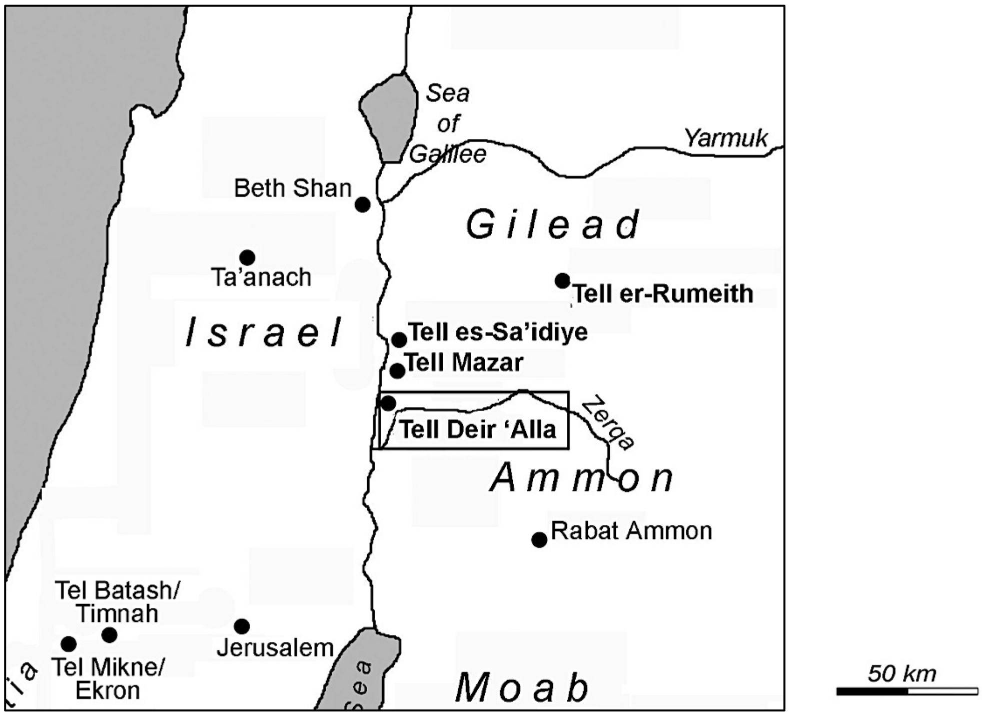
Flimsy built complexes with small, interconnected rooms and few open spaces characterized the settlement. The buildings were mainly used for domestic purposes, such as storage, weaving, food preparation and dining. A remarkable aspect of this village is the abundance of loom weights, indicating that the village was specialized in textile production (Boertien 2004). In the excavated area about 14-15 households could be determined (van der Kooij and Ibrahim1989:86-87).

Phase IX / M was dated to the end of the 9th century BC (Iron Age IIB) (Van der Kooij and Ibrahim 1989, 82; Van der Kooij 2001:297,301; 2002:63). Van der Kooij (2002: 64) described the final stage of the village as follows: 'In its final stage of existence the settlement underwent a sudden destruction by an earthquake, followed by fires that broke out at many places destroying the village. People had time to leave their homes safely, but they left most of their possessions behind.' The debris left by the fire had been relatively untouched by either erosion or later inhabitants. As a result, provenance of the objects belonging to this phase could securely be established (Van der Kooij and Ibrahim 1989:80-82).

The fire that destroyed Tell Deir Alla left the remains of the many looms in the exact place where they had been used. The unfired clay weights were baked in the fire that followed the earthquake and were found preserved in situ in the debris (Van der Kooij and Ibrahim 1989:80-82). Although only the charred wood of one wooden frame of a loom survived (see below 6.4, group 13), the 675 clay loom weights that were discovered indicate that the warp-weighted loom was in general use at Deir Alla. Besides loom weights other tools for textile production were found such as spinning whorls, bone spatulas, pin beaters and needles. Thanks to the detailed way of digging used in the Deir Alla project, a small piece of textile and some thread were found in connection with the loom weights. This unique find made it possible to tell more about the kind of textile produced on the warp-weighted loom in this village in the Levant during Iron Age. Phase IX is of particular interest for the textiles and textile production in the Levant region, because of the quantity of relevant material recovered from the occupied layer. (See also below 6.7).

[67] This phase was called Phase M during the excavations of 1960-1967.

In a special room in the settlement (room EE 335) a text devoted to Balaam bar Beor was found. The text was painted on one of the walls (Hoftijzer and Van der Kooij 1976, 1991; Puech 2008). Wenning and Zenger speculated this room to be a local school for prophets devoted to Balaam (1991:189). Van der Kooij (2002:68-69) writes: ‘The room and surroundings show no specific religious activities, no cultic use. [...] Ethnoarchaeology adds hardly any information. Historical texts of this kind may have a religious use in a teaching context (‘class room’). ‘
However, Franken, who excavated the text, calls this room a *cella* and suggests it to be a sanctuary located in the Iron Age village, just as the Late Bronze Age village had a sanctuary (1999; 2008). According to Franken the combination of the artificial hill (tell) with the building on top, the Balaam text and a number of associated objects justify an attempt ‘to interpret the ruins as the remains of a Baal height.’ (Franken1999:193). Franken sees a relationship between the textile production at the site and its religious function. I have further studied this aspect, and my conclusion is that the room with the Balaam inscription had a religious function (Boertien 2007; 2008 and Chapter 12.3).



Map 6.1. Map of the Central Jordan Valley.

6.2 Textile remains from Deir Alla phase IX

The identification of textiles made out of hemp is one of the unexpected discoveries of Deir Alla. (Vogelsang-Eastwood 1989:58).

In phase IX, a fragment of textile and some threads were excavated. A fragment of cloth in tabby weave was found between the loom weights in a room in the northeast corner of square B/A6. In the northwest corner of the room next to it (B/A7) 41 loom weights were found; one weight contained some threads inside the perforation.[68] W.D. Cooke of Manchester University

[68] The relationship between the finds in B/A6 and B/A7 is not yet clear; once the stratigraphy of this period is published, hopefully a more detailed interpretation will be possible. The cloth shows a tabby weave, while some of the loom weights that are visible in the photographs are aligned in three rows, which indicates that a twill weft was produced on that particular loom.

Department of Textiles analyzed both finds using a Scanning Electron Microscope. He concluded that both the cloth and the threads were made of hemp and that the cloth had never been used. (W.D. Cooke, Dep. of Textiles, University of Manchester, report 26 June 1989).

a) Fragment of cloth (fig. 6.1)

This consisted of a small fragment of fabric, 52x32 mm, in a tabby weave. The cloth was very fine and made of Z-spun hemp thread. The thread count per cm is 24 tpcm (threads per cm) for the warp and 20 tpcm for the weft. The warps – being the basis of the fabric – were usually more tightly spun than the wefts as they become thinner during the weaving process. Stronger spun, thinner and more numerous threads are therefore considered to be warp threads (Sheffer and Tidhar 1991:3). There is no sign of wear or washing, indicating that the cloth had just been woven when the loom was destroyed by fire (Vogelsang -Eastwood 1989: 61).

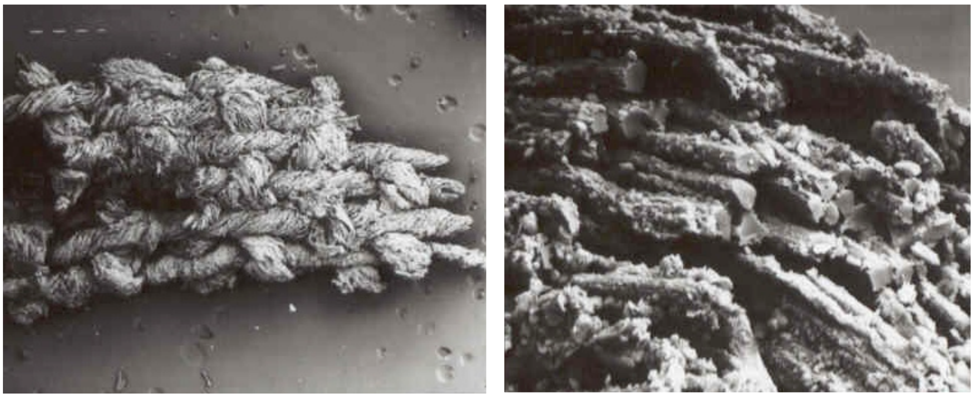


Fig. 6.1. The fragment of cloth – left enlarged 13x and right enlarged 810x.

b) Threads (fig. 6.2)

The threads are part of a cord that was used to tie the weights to the warp threads. This cord is made of hemp and the diameter is 1.5 times as thick as the yarn in the fabric. Hempen fibre was thus used in both the cord and the fabric, but the twist level in the cord is lower than the yarn systems in the fabric fragment. Cooke, who analyzed the material, concluded that the thread was part of the separate cord used for tying the weights to the warp threads, and the fabric on the loom burnt and fell on top of the weights. (W.D. Cooke, Dep. of Textiles University of Manchester, report 26 June 1989).

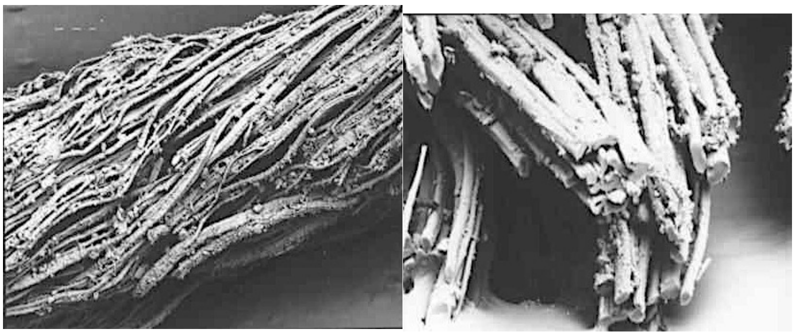


Fig. 6.2. The cord – left enlarged 150x, right enlarged 1000x.

The analysis of these textile fragments thus showed that hemp was used to make a very fine cloth. This opens up many questions because up till now Deir Alla seems to be the only place in the Levant in this period where fibre hemp was produced. Some evidence for hemp has been found in the Christmas Cave in the Kidron Valley near the Dead Sea in Israel yielded two samples showing traces of hemp, Cannabis sativa L. DNA (Murphy at al. 2011). No documentary sources are known from the Levant. Fibre hemp is known from Central Europe where hemp was used widely for textiles in the steppe zone since the Neolithic period, and in East Asia where Neolithic pots with textile impressions have been found (Barber 1991:17; Shishlina, Orfinskaya and Golikov 2002) (see Chapter 2.1). Fine hempen cloth is still produced nowadays and used for all kinds of clothing and furniture. Whether hemp was imported or grown and processed in the Jordan Valley itself can only be guessed at. However, the climatic and soil conditions of the Jordan Valley do allow hemp to grow there (see 6.7).

6.3 The loom weights from phase IX

From phase IX, 675 loom weights have been registered, 589 of which could be studied.[69]

This chapter differs from the following chapters because my study of the loom weights of Tell Deir Alla served as a pilot study of the loom weights from Transjordan. This enabled me to develop my ideas and methods to analyze the manufacturing and clay composition of loom weights and to establish how they were used in the weaving process. Part of this process is incorporated in the descriptions of the weights, serving as basic information for the simulation experiment (Chapter 4). The information on the shape and number of the loom weights used on a loom was tested on this collection (6.5) and will not be repeated in the chapters on Tell Mazar (Chapter 7), Khirbet al-Mudayna (Chapter 8) and Tell er-Rumeith (Chapter 9). The weights from Deir Alla were used to design a preliminary typology (figs. 6.4, 6.6 and 6.12) that could be used and tested on the loom weights from the other sites under study, finally resulting in a general typology of perforated Iron Age clay loom weights from Transjordan (Chapter 10).

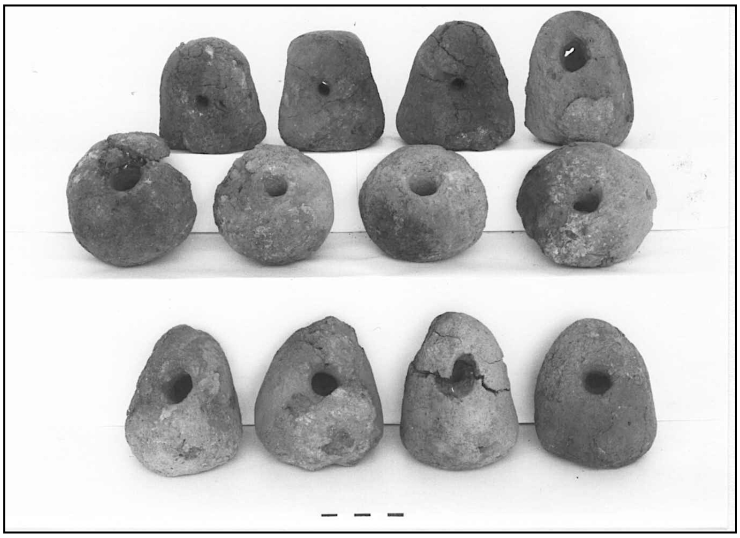


Fig. 6.3. Several loom weights from Deir Alla, phase IX.

Clay and temper

The clay of the excavated loom weights showed sand and organic matter, together with small and large stones. Because some of the stones inside the loom weights were extremely large (over 1.5 cm in size) I presumed in an earlier article that the clay used for the loom weights was not selected but gathered without paying attention to the mixture (Boertien 2004:325). This appears to be a mistake because many loom weights were made of selected (fine) clay and different tempers were added to the mixture. According to Franken and Steiner (1990:79): "Temper indicates the non-plastic elements in a clay, which are considered to have been added by the potter (........); fillers are used inter alia to open the clay for texture and/or workability, to control drying shrinkage and firing shrinkage." Since the loom weights were not fired, the tempers and fillers were added in

[69] Eighty-six recorded loom weights were not traceable because they were taken out of the collection to be exhibited and subsequently disappeared.

order to control shrinkage while drying. Additional information on the clay analysis can be found in Chapter 4.

Types of loom weights (figs. 6.4, 6.6 and 6.12)
The 589 loom weights revealed several types of perforated weights (see Chapter 4 for an description of the production processes of the various types). Only in one group was a non-perforated loom weight registered (Chapter 6.4, group 12, figs. 6.20 and 6.21).

Perforated loom weights can be divided into two main categories: horizontally perforated weights, which are pendant loom weights, and vertically perforated loom weights that will be referred to here as centrally perforated loom weights.

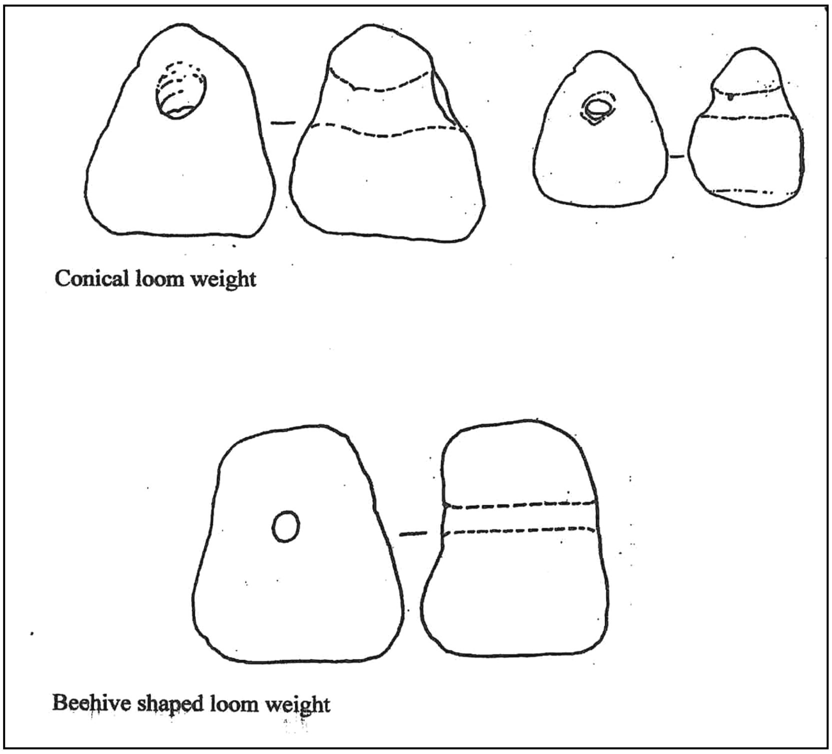
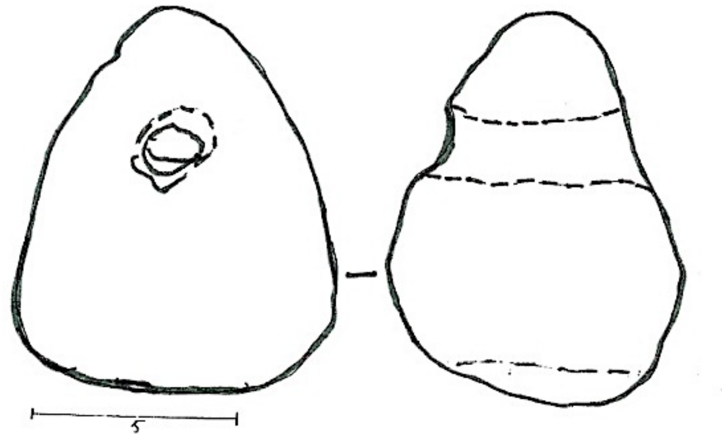


Fig. 6.4. Horizontally perforated (pendant) loom weights.

Horizontally perforated loom weights, pendant form
The pendant loom weight was perforated in the upper part of the weight, while holding it in a horizontal position.

1. Conical loom weight (fig. 6.4 upper row).

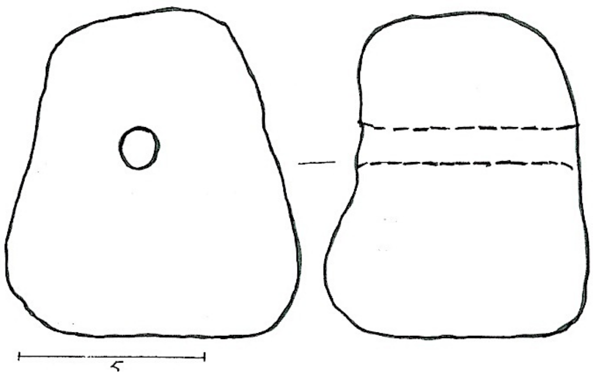


Characteristics: conical body with a circular or elliptical base. The diameter of the perforation varies from 0.5 to more than 2 cm. The clay is mostly impure and often not mixed well.
Sixty-two conical loom weights were found; that is 10.5% of the total amount of loom weights in Phase IX. Twenty-three weights came from square B/E9, groups 12 and 13 (see Chapter 6.4).

Averages of 62 conical loom weights

height	8.4 cm
diameter	7.5 cm
perforation	2.0 cm
weight	433.5 g

2. Beehive-shaped loom weight (fig. 6.4 bottom row).



Characteristics: conical body, flattened top and bottom. The narrow perforation was always made with a stick through the middle of the weight and measures 1-1.4 cm in diameter. This type has a pendant shape with a narrow perforation in the middle of the weight. The difference with the conical weight is the flat top and the position and the size of the very small perforation. The beehive-shaped loom weight is perforated with a stick, and a stick or possibly a rod was used to attach the weight to the warp threads. This technique is known from a loom weight stamp published by Davidson (1952:148 no. 4, fig. 25, no. 1145; see also Chapter 4, fig. 4.5). The weights from Deir Alla do show traces of a stick used in the beehive-shaped loom weights.[70] The clay is impure and contains a lot of mudstone and small-sized organic matter. The beehive-shaped loom weight is seldom found in collections dated to the Iron Age in the Levant. Only eight loom weights of this type have been found in Deir Alla phase IX; that is 1.4%. The beehive-shaped loom weight looks like the Neolithic weights found in Europe (Switzerland), which were used to produce fine linen (Barber 1991:96, fig. 3.18).

Averages of 8 beehive-shaped loom weights

height	7.8 cm
diameter	7.4 cm
perforation	1.4 cm
weight	424.3 g

Fig. 6.5. Beehive-shaped loom weight (l) and two conical weights (see also fig. 6.3. row 1).

[70] This was suggested by McLaughlin (1981) based on the work of Davidson and Thompson (1943) regarding the loom weights from Athens now in the British Museum. Some of these loom weights have a metal ring in the narrow perforation, but such rings have not been found in the Levant.

Centrally (vertically) perforated loom weights
These loom weights were perforated in the centre of the weights by holding the weight in a vertical position, which can be seen by the fingerprints left on the loom weight when the clay was still wet.

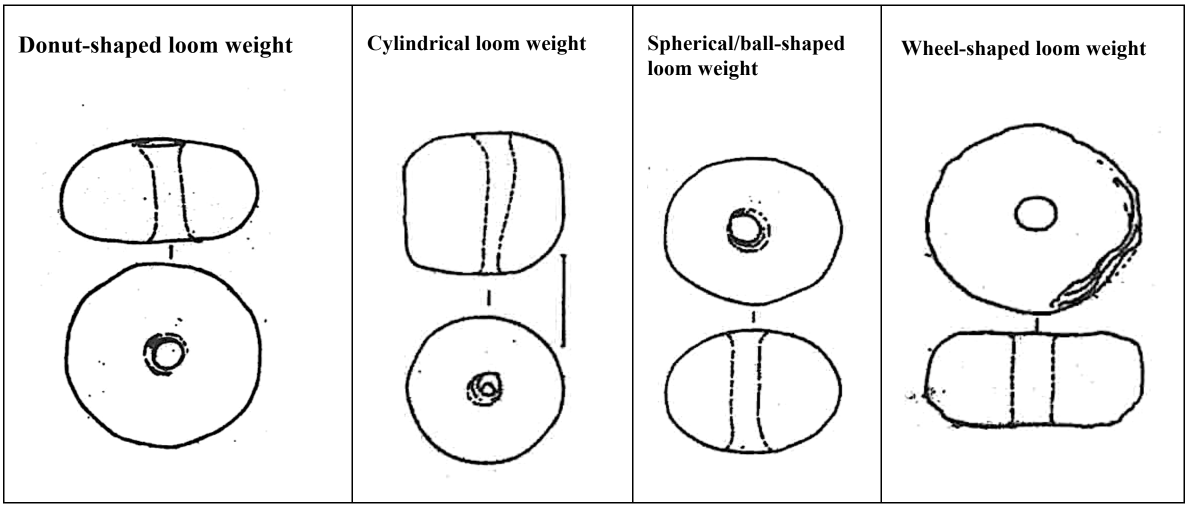


Fig. 6.6. Centrally (vertically) perforated loom weights.

*3. Donut-shaped loom weight*s
The donut-shaped loom weight is the most popular loom weight in the Southern Levant in the Iron Age, and in Deir Alla phase IX, 322 donut-shaped loom weights were registered. Characteristics: the weight was made from a coiled piece of clay < 9 cm in length and < 3 cm in diameter. This coil was then wound around the finger to create the shape and the perforation. Donut-shaped loom weight (regular). Characteristics: less than 9 cm in diameter. The width is 1 cm greater than the height. The perforation diameter is 1-2 cm.
The *bi-conical weight* is a variation within the donut-shaped loom weights. The elliptical shape is non-discriminating, and the weight was made in the same way as the donut-shaped weights, resulting in identical characteristics: less than 9 cm in diameter. The width is 1 cm greater than the height and the perforation diameter is 1-2 cm. Two hundred and eighty-eight regular donut-shaped loom weights (with a width/diameter under 9 cm) have been found.

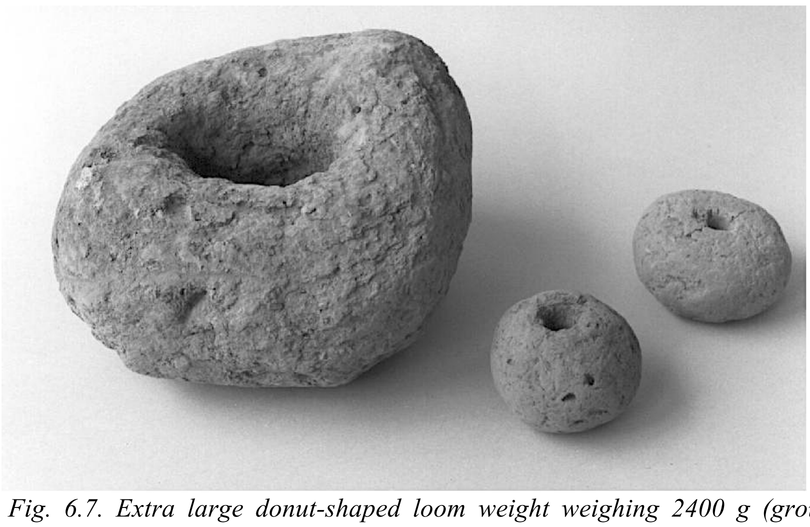
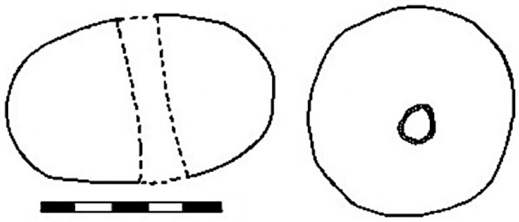
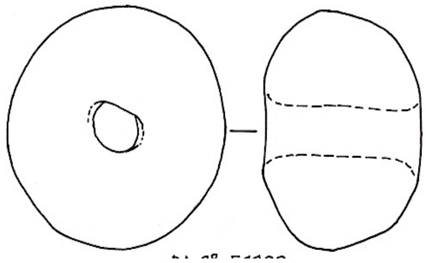


Fig. 6.7. Extra large donut-shaped loom weight weighing 2400 g (group 2); two regular- sized loom weights (r), one donut-shaped one (above), and one spherical one (below).

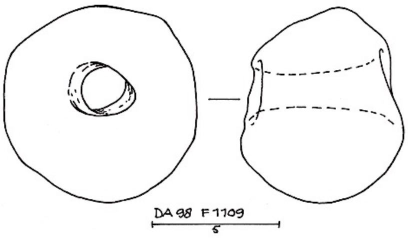
Several large donut-shaped loom weights (with a diameter of more than 9 cm) were found. They were made from a coiled piece of clay that was too long to be hand-held or wound around the finger; the weight was shaped on a horizontal surface creating one flat side.
Characteristics: > 9 cm in diameter. The perforation was made with a stick. The perforation diameter is usually 1-2 cm. Thirty-four large donut-shaped weights have been found (See also Chapters 4 and 10).

Donut-shaped loom weight 'prototype'

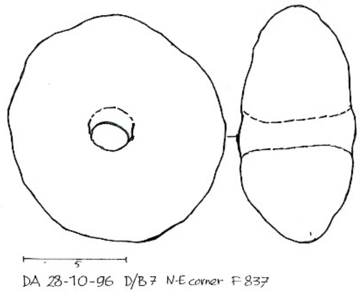




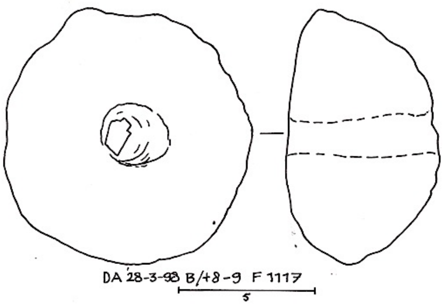
Donut nr. DA 26



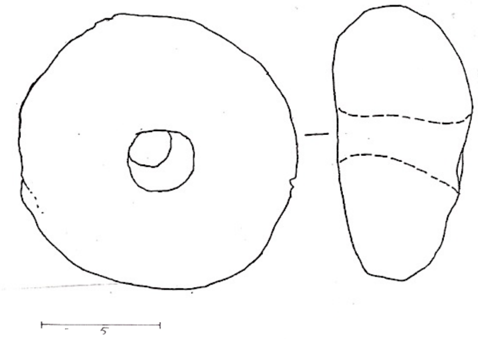
Donut nr. DA 19



Donut nr. DA 56



Large donut nr. DA 127



Large donut nr. DA 125

Fig. 6.8. Variations in donut-shaped loom weights from Deir Alla phase IX (see also fig. 6.26).

Averages of all 322 donut-shaped loom weights

height	5.1 cm
diameter	8.0 cm
perforation	2.1 cm
weight	335 g

4. Spherical / ball-shaped loom weight.

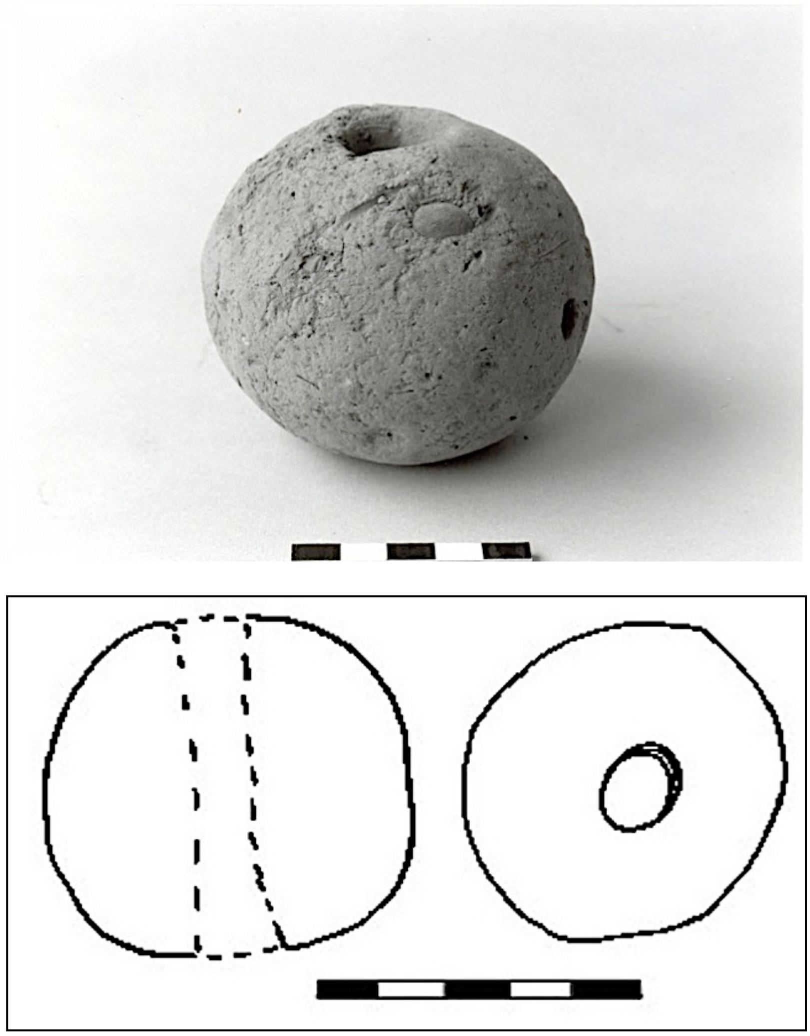


Fig. 6.9. Spherical / ball-shaped loom weight.

Spherical loom weights never vary more in diameter and height than 0.8%, causing the typical ball shape. Characteristics: width and height vary no more than 1 cm. Ball-shaped loom weights are over 5 cm in diameter and the perforation diameter is over 1 cm, created with a stick. Twenty percent of the 86 spherical loom weights have a flat side, caused by the use of very wet clay. It is difficult to form a good ball from rather dry clay, and using wet clay gives a nice and smooth ball, but it is difficult to dry this model while keeping the spherical shape. Selected clay is usually used for this model, and the clay is fine and well mixed. It is surprising that rather large stones are found inside the weights, which would have caused problems while drying (fig. 6.9). Spherical loom weights often occur in large groups of loom weights, and within these groups their percentage is usually high.

Averages of 86 spherical /ball-shaped loom weights

diameter	7.8 cm
perforation	2.1 cm
weight	441.4 g

5. Cylindrical loom weight

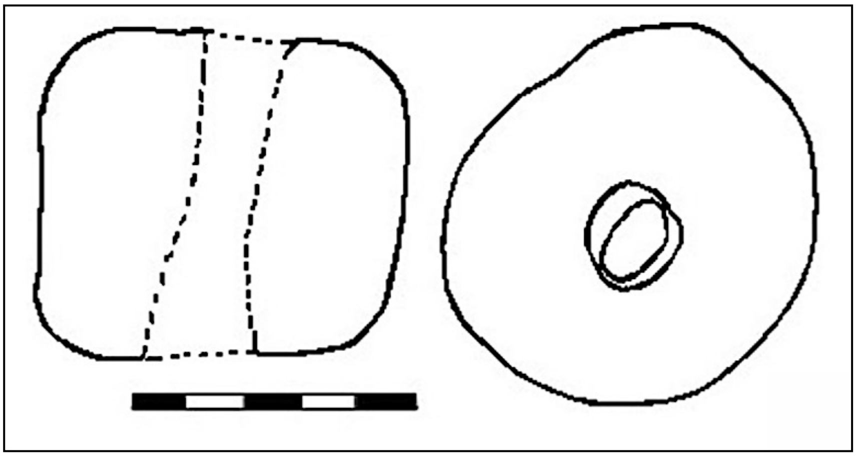


Fig. 6.10. Cylindrical loom weight.

Characteristics: width and height vary no more than 1 cm, flat ends, and the perforation diameter is over 1 cm. The difference between the heights and widths of the cylindrical loom weights is never more than 0.8%. The cylinders are always more than 5.5 cm high and about 7.5 cm wide. The clay is fine yellowish or banded (Lisan/Damiyah) clay.

Averages of 23 cylindrical loom weights

height	6.0 cm
diameter	7.5 cm
perforation	1.5 cm
weight	452.6 g

6. Wheel-shaped loom weight

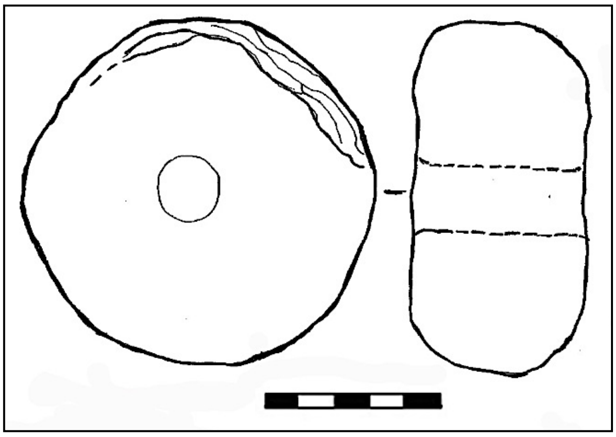


Fig. 6.11. Wheel-shaped loom weight.

Characteristics: width more than 1 cm greater than the height, more or less flat ends. Usually over 9 cm in diameter and the perforation diameter is over 1 cm. The wheel-shaped loom weight is not commonly known in the Southern Levant. The only place where they have been reported is Tel Qasile, on the coastal plain. The cylinders of Tel Qasile are flat and comparable to the wheel-shaped weights as described in this volume. Orit Shamir calls these loom weights *cylindrical*; she registered 66% of the weights as cylindrical. The average weight of the wheel-shaped loom weights in Tel Qasile is 340.8 grams, lighter than those from Deir Alla. Regarding their shape the cylindrical loom weights of Tell Qasile are comparable to those from Deir Alla. The average diameter is 8.35 cm; the average height in Tel Qasile is 5.35 cm. This is slightly taller than the ones from Deir Alla (5.1 cm), but not as tall as the loom weights I classified as cylindrical weights, which are 6 cm tall. The clay used in Tel Qasile is not selected and thus contains stones and organic matter. The clay used for this type of weight in Deir Alla is a fine and selected type of clay, without stones, resulting in well-mixed fine clay.

Averages of 41 wheel-shaped loom weights

height	5.1 cm
diameter	8.3 cm
perforation	2.0 cm
weight	439.2 g

7. Mixed forms

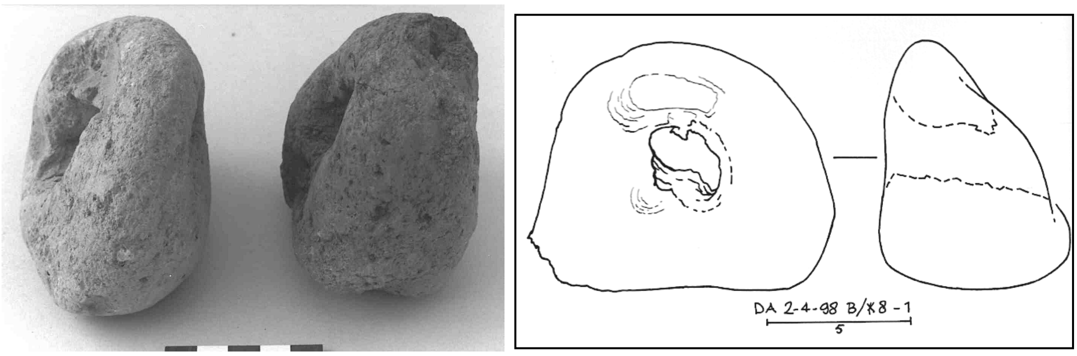


Fig. 6.12. Mixed form.

Mixed forms are loom weights showing characteristics of three types of loom weights: the wheel-shaped, the cylindrical and the donut-shaped loom weights. Their shape is the result of the production process: when a weight is of a medium size and a stick or a finger is used to form the weight, only the final steps decide what type is being produced (see Chapter 4). This results in loom weights of a mixed type, 9 cm in diameter. The mixed category does not occur with larger loom weights because in the case of a larger weight the forming techniques are fundamentally different. The description of the forming process can be found in Chapter 4.

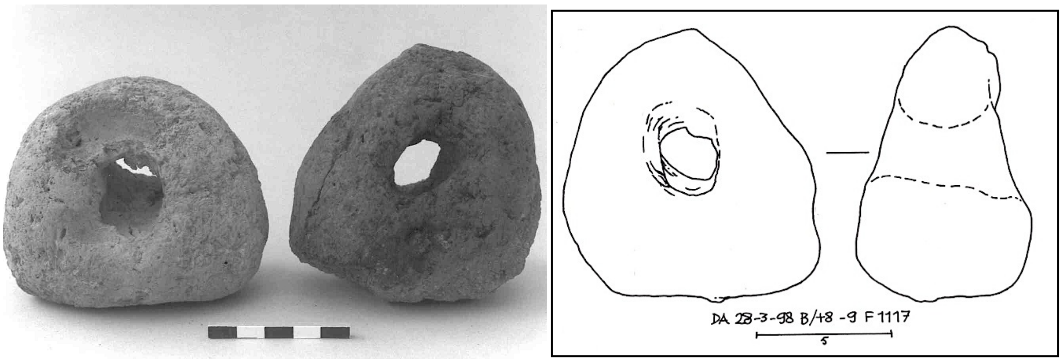


Fig 6.13. Mixed form.

Averages of 26 loom weights (mixed forms)

height	5.1 cm
diameter	7.6 cm
perforation	1.7 cm
weight	350.1 g

Remainder

This category includes the loom weights that do not belong to one of the major types of this period. The group consists of 21 loom weights of different shapes and weights.

- There are three oblong loom weights, which are tall cylindrical weights with a horizontal perforation. Two of these were found in B/D9: one specimen was found in locus 18 and the other one in locus 9. One more oblong loom weight was recovered from B/D8 (locus 6).
- Three loom weights belong to the ovoid type, which is an egg-shaped weight with a horizontal perforation, comparable to the ovoid weights as described by Shamir (1996:136). All these ovoid weights were found in square B/D9 (loci 18, 25 and 43).
- A spool/reel-shaped non-perforated loom weight comes from B/E9 (DA F889/505).

The spool-shaped loom weight (fig. 6.20) is made of banded Damiyah/Lisan clay, just as the other loom weights within the group in which it was found, but the clay of the spool-shaped loom weight is different because it was not mixed well and contains small and medium-sized organic matter and medium-sized fragments of grog. The spool-shaped loom weight has the following

characteristics: height 8.5 cm, diameter 7-6 cm, weight 430 grams. The shape of the spool is comparable to the spools from northern Syria (Cecchini 2000:212). More about the non-perforated loom weight from Deir Alla and the connection with the north has been published in Boertien 2009b. (See also Chapter 10.4).
- Fourteen loom weights were characterized as amorphous because they were damaged and thus the type was not identifiable.

Type	**Number**	**Percentage**
Donut-shaped	322	54.8 %
Spherical/ ball-shaped	86	14.6 %
Conical	62	10.5 %
Wheel-shaped	41	6.9 %
Cylindrical	23	3.9 %
Mixed type	26	4.3 %
Beehive	8	1.4 %
Spool-shaped un-perforated	1	0.2 %
Oblong	3	0.5 %
Ovoid	3	0.5 %
Amorphous	14	2.4 %
Total	*589*	*100 %*

Table 6.1. All the studied loom weights from Deir Alla phase IX.

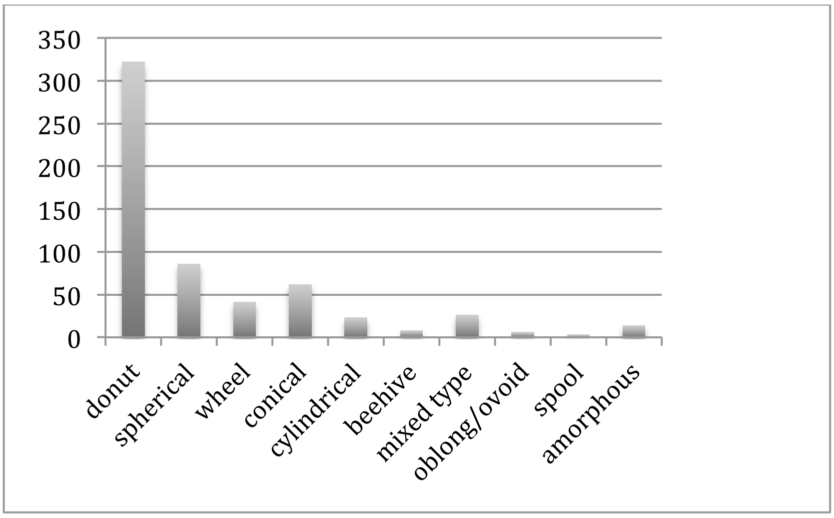


Fig. 6.14. Numbers of loom weights by type from Tell Deir Alla phase IX (Iron Age II) n=589.

6.4 The loom weights of phase IX: large groups arranged by square and locus

Fifteen large groups of weights, each of which might represent a loom, could be distinguished. To determine whether a group of loom weights belong to a single loom, the square and locus they were discovered in were taken as selection criteria. (See Chapter 4.1). The following groups could be distinguished:

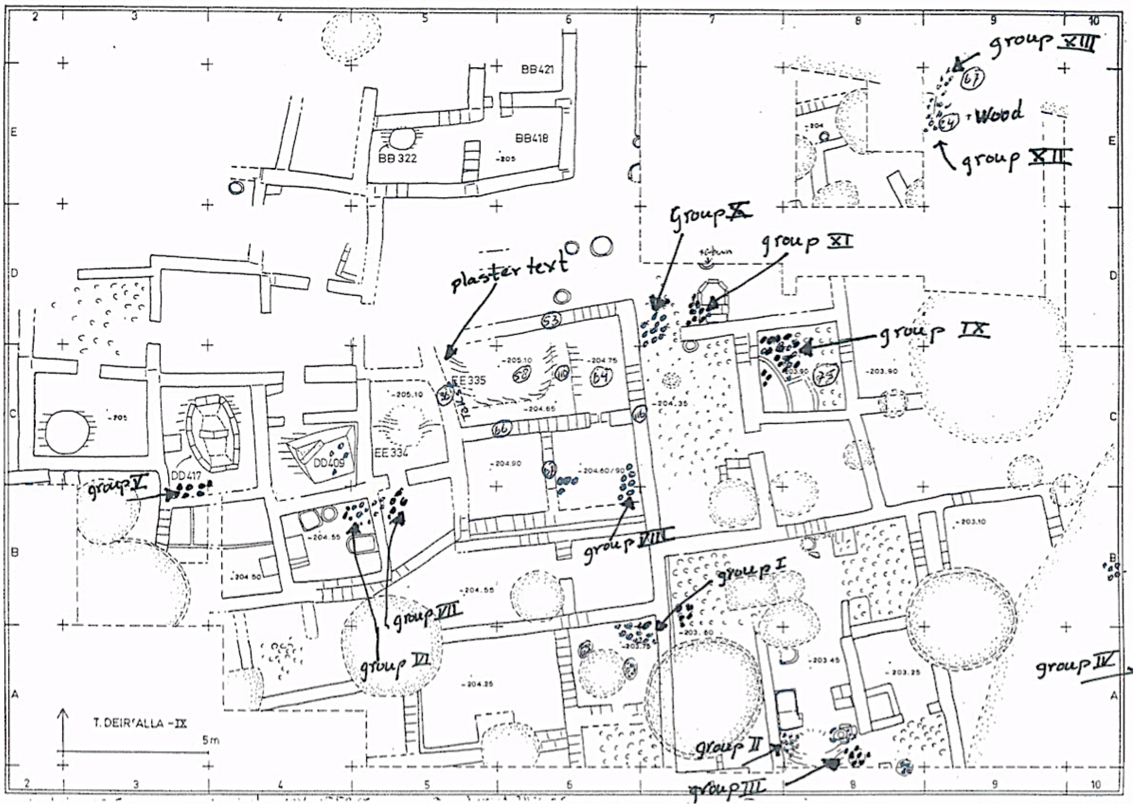


Fig. 6.15. Plan Deir Alla phase IX showing where the large groups of loom weights were found.

Group 1

B/A7 locus 60 and B/A6 locus 122. These two loci are located in a small room that has an entrance into a courtyard to the south. A total of 41 weights were found lying in three rows (fig. 6.16 and Vogelsang-Eastwood 1989:60, fig. 72) in the northeast corner of the room. The cloth fragment and the thread from inside a loom weight (Chapter 6.2 and fig. 6.2) were both found in these two loci.

Type	Number	Weight range in grams
Donut-shaped	27	240-665
Spherical/ball-shaped	7	290-600
Conical	3	185-610
Wheel-shaped	1	270
Mixed type	3	330-440
Total	*41*	*Average weight 357*

Table 6.2. Group 1.

Group 2

B/A8 locus 55. The 33 loom weights were found in a storeroom which also contained several jars, a dish and a jug-stand, and next to a bin made of clay plaster with potsherds. The weights were found lying in four rows. The room has been reconstructed and is described in Van der Kooij and

Ibrahim (1989: 82-85, fig. 102). The loom weights are of different types and an extra large donut-shaped loom weight was found within this group (fig. 6.7 left).

Type	Number	Weight range in grams
Donut-shaped	19	160-2400
Spherical/ball-shaped	3	140-180
Conical	3	335-400
Wheel-shaped	3	330-350
Cylindrical	3	260-380
Beehive-shaped	2	360-460
Total	*33*	*Average weight 379*

Table 6.3. Group 2.

Fig. 6.16. The loom weights of group I as they were found in situ lying in rows.

Group 3

B/A8 locus 63. This group of 11 weights could have been part of Group 2 in locus 55. The loom weights were found amongst pots meant for the production of yoghurt, and with a number of storage jars with unknown burnt contents and with dung probably to be used as fuel (Van der Kooij and Ibrahim 1989: 84). The plan shows that these weights were lying in a circle, between the pots; they may have been kept in a basket that burned away (fig. 6.17 foreground). A comparable situation was found at Tell Mazar (Chapter 7.3, fig. 7.40).

Type	Number	Weight range in grams
Donut-shaped	6	335-405
Spherical/ball-shaped	3	320-335
Conical	2	130-390
Total	*11*	*Average weight 311*

Table 6.4. Group 3.

Group 4

B/A10 locus 26. No plan of this square is yet available. Ten loom weights of different shapes were found in this locus.

Type	Number	Weight range in grams
Donut-shaped	2	320
Spherical/ball-shaped	2	275-295
Wheel-shaped	6	335-475
Total	*10*	*Average weight 327*

Table 6.5. Group 4.

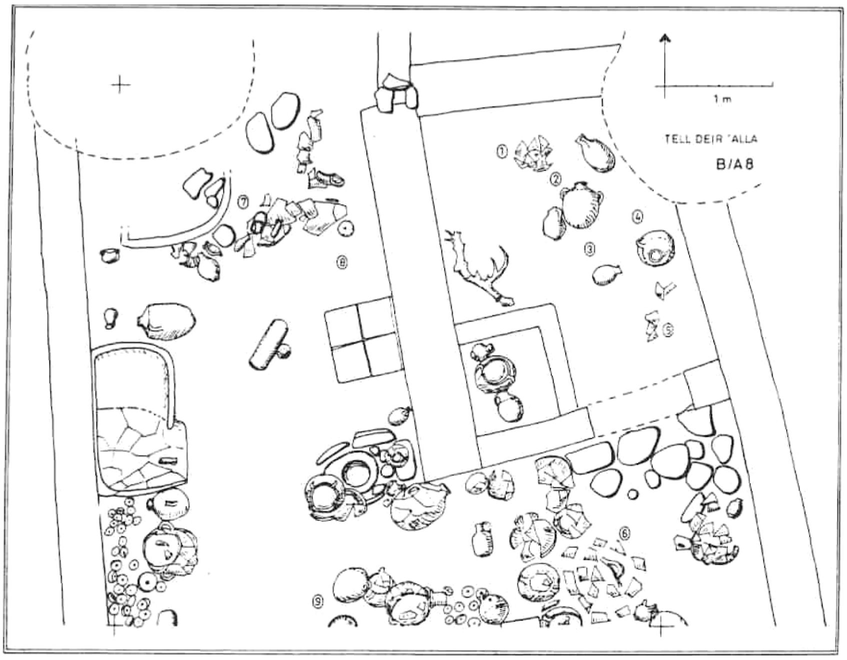


Fig. 6.17. Reconstruction of the rooms in BA8 with group 2 (left) and group 3 (foreground). (Van der Kooij and Ibrahim 1989:82).

Group 5

B/B3 locus 38. This is the southern part of room number DD417 (fig. 6.15) in which a mudbrick-lined pit was located. Twelve loom weights were recorded here.

Type	Number	Weight range in grams
Donut-shaped	9	225-435
Spherical/ball-shaped	1	285
Conical	2	360
Total	*12*	*Average weight 232*

Table 6.6. Group 5.

Group 6

B/B4 locus 83. This is a small room with mudbrick constructions and basins, south to room DD409 (fig. 6.15). Fourteen weights were recorded from this locus.

Type	Number	Weight range in grams
Donut-shaped	11	220-520
Spherical/ball-shaped	3	515-575
Total	*14*	*Average weight 382*

Table 6.7. Group 6.

Group 7
B/B5 locus 129. This is a small open courtyard next to room DD409 (fig. 6.15). Thirteen loom weights were found in this area. It seems that the loom weights of groups 6 and 7 were scattered around both in the room and the courtyard. The looms probably stood on the roof and fell down together with the roof material.

Type	Number	Weight range in grams
Donut-shaped	10	200-390
Spherical/ball-shaped	2	490-530
Conical	1	1550
Total	*13*	*Average weight 320*

Table 6.8. Group 7.

Group 8
B/C6 locus 117. This is a small room belonging to the complex with the benched room where the Balaam text was found (Room EE335, top-plan fig. 6.15). A group of 29 loom weights were found here in three rows.

Type	Number	Weight range in grams
Donut-shaped	15	205-465
Spherical/ball-shaped	6	265-525
Wheel-shaped	4	270-430
Mixed type	4	415-275
Total	*29*	*Average weight 353*

Table 6.9. Group 8.

Group 9
B/C8 locus 75. This is a room with a pavement of cobbles, next to a cobbled courtyard with a large amount of plant material. This plant material has been macroscopically analyzed and is defined as layers of reed laid down on a muddy pavement (Van der Kooij 2002:68). The plant material still has to be microscopically analyzed, as it might be hemp left there in the open air on the cobbled pavement of the yard for drying or retting. The 52 loom weights were found scattered in the area. It is likely that a loom stood on the roof of this building and fell down into the room (fig. 6.18).

Type	Number	Weight range in grams
Donut-shaped	15	190-550
Spherical/ball-shaped	6	125-500
Conical	1	460
Wheel-shaped	16	405-595
Cylindrical	8	425-640
Beehive-shaped	1	250
Mixed type	5	335-490
Total	*52*	*Average weight 370*

Table 6.10. Group 9.

Group 10
B/D7 locus 52. This is the entrance (north side) to the cobbled courtyard mentioned above. Sixteen loom weights were found lying in three rows. A loom probably stood in the doorway between the room and the courtyard where several bread ovens were located.

Type	Number	Weight range in grams
Donut-shaped	10	220-465
Wheel-shaped	1	430
Cylindrical	3	420-480
Mixed type	2	405-570
Total	*16*	*Average weight 378*

Table 6.11. Group 10.

Group 11

B/D7 locus 54. This locus is located in the cobbled courtyard described above. Seventeen loom weights were found in three rows (fig. 6.19).

Type	Number	Weight range in grams
Donut-shaped	4	305-460
Spherical/ball-shaped	4	355-520
Wheel-shaped	7	450-500
Mixed type	2	500-520
Total	*17*	*Average weight 393*

Table 6.12. Group 11.

Fig. 6.18. The scattered loom weights of group 9.

Fig. 6.19. Some of the loom weights of group 11.

Group 12

B/E9 locus 24. This area is located in the roofed room partly paved with cobblestones, mentioned above. Thirty-four loom weights were lying in three rows next to a large krater (fig. 6.21). Exactly the same kind of krater (with handles) and a hoard of loom weights were found at Ta'anach (Lapp 1964, fig. 13). At Ta'anach the loom weights were lying next to the krater and the krater was also filled with loom weights, at Deir Alla the krater did not contain loom weights. A comparable krater was found at Mazar Mound A (Yassine and Van der Steen 2012:19 and fig. 40 G) dated to the 10th century BC. This group contains a special weight: a non-perforated spool-shaped one, which was found together with the perforated weights (figs.6.20 and 6.22). In group number 12 three fragments of loom weights were found made from the same kind of clay, but the type of these weights could not be identified. They might have been spool-shaped weights as well. The donut-shaped weights in this group are of the common type, but the conical and beehive-shaped loom weights also look very similar to the loom weights from northern Syria (Cecchini 2000:224) – see also figs. 6.5 and 6.22.

Type	**Number**	**Weight range in grams**
Donut-shaped	12	255-480
Conical	15	320-500
Beehive-shaped	4	460-500
Spool (non perforated)	1	430
Amorphous	2	320-500
Total	*34*	*Average weight 347*

Table 6.13. Group 12.

Fig. 6.20. Spool-shaped loom weight from Deir Alla (group 12).

Group 13

B/E9 locus 67. Here fourteen loom weights were found lying in two rows, together with charred wood. The loom stood to the north-west of group 12, inside the roofed room partly paved with cobblestones and next to a lined shallow mudbrick pit comparable to the one in room DD417 (fig. 6.15), and near a small mudbrick table/construction filled with carbonized linseed.

Type	Number	Weight range in grams
Donut-shaped	7	400-540
Conical	6	355-520
Beehive-shaped	1	445
Total	*14*	*Average weight 379*

Table 6.14. Group 13.

Fig. 6.21. The loom weights of group 12 above the large krater.

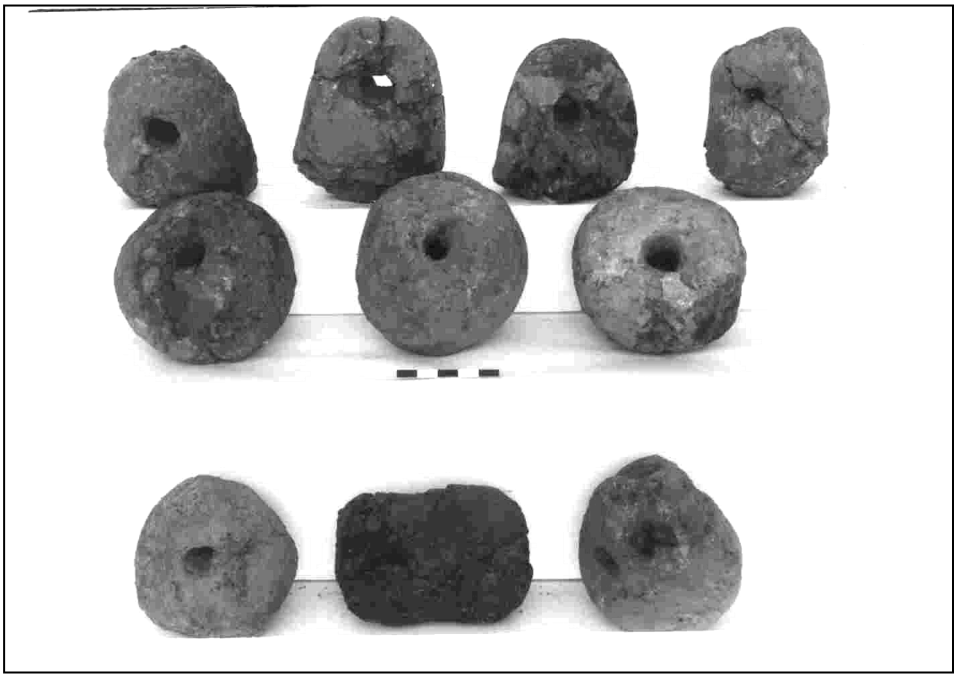


Fig. 6.22. Some loom weights from group 12. The upper row shows some conical weights together with a beehive-shaped weight. The middle row shows donut-shaped weights. The bottom row shows the spool-shaped non-perforated weight in the middle with a conical weight on either side.

Group 14

D/D7 locus 123 = D/C7 locus 100. This area falls outside the published plans (figs. 6.15 and 6.17). This very large group of 98 weights was found together with carbonized organic material, which has not yet been analyzed. No drawings are available, but the picture (fig. 6.23) suggests that there were two different groups: a group situated vertically (left) and a group in a diagonal position, both consisting of four rows of loom weights. Because the two groups were excavated as one and therefore were not labelled separately, it was impossible to distinguish between them.

Type	Number	Weight range in grams
Donut-shaped	68	190-460
Spherical/ball-shaped	12	225-1050
Conical	2	445-575
Cylindrical	8	260-575
Mixed	8	240-305
Total	*98*	*Average weight 267*

Table 6.15. Group 14.

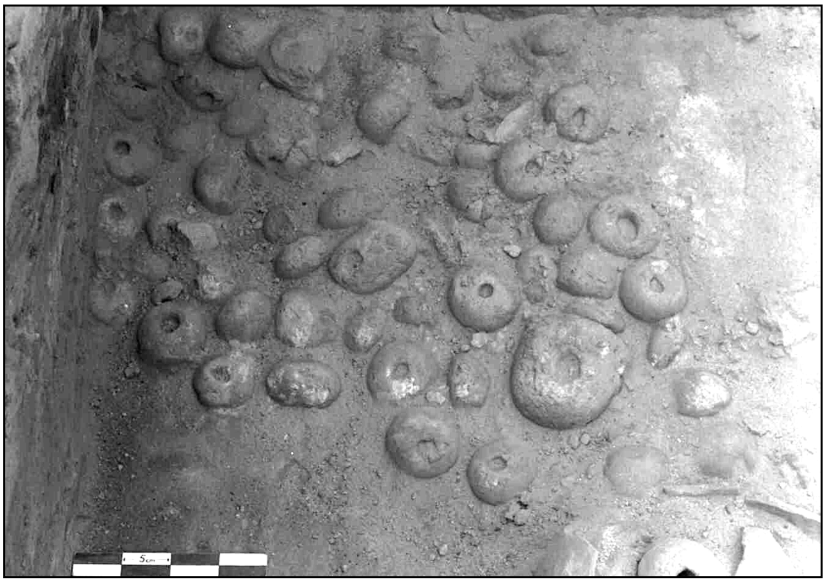


Fig. 6.23. The loom weights of group 14, vertical (left) four rows, diagonal (right) four rows.

Group 15

B*8 locus 9. This location is not on the plan and no pictures or drawings are available recording the findspot. The group was found together with carbonized organic material that has not yet been analyzed. Group 15 is very interesting because of the strange shapes and mixed types used within a set of loom weights.

Type	Number	Weight range in grams
Donut-shaped	13	300-400
Spherical/ball-shaped	4	129-310
Conical	5	330-450
Mixed type	1	470
Amorphous	1	270
Total	*24*	*Average weight 338*

Table 6.16. Group 15.

6.5 Interrelationship between different types of loom weights

At first sight there seems to be no logical relationship between the different types of loom weights used on a loom. Browning states that at Timnah (Tel Batash) the conical loom weights and the donut-shaped weights are used within a household at a ratio of 1:5 (1988). This is a comparison between loom weights with a horizontal perforation and those with a vertical perforation. At Deir Alla this ratio is 1:6, but many more different shapes were found at Deir Alla than at Timnah. In Deir Alla phase IX the ratio of weights with a horizontal perforation to weights with a vertical perforation is 1:7.

I decided to use a statistical method to investigate the interrelationship between the loom weights used on the looms at Deir Alla. The following calculations are based only on the loom weights from the fifteen large groups just discussed. The *correlation coefficient* is the measure of the interdependence between two variables. This statistical technique can be used to investigate whether two groups of objects show some kind of association. In this case the variables are the various types of loom weights occurring together in one group. The correlation coefficient is thus a figure expressing the strength of the relationship between the variables (both positive and negative).[71] When a correlation coefficient is 0.70 or higher, this points to a strong relationship between the variables. When a correlation coefficient is below 0.40, the variables are regarded to be non-correlated. A correlation coefficient between 0.40 and 0.70 is regarded as an interesting coefficient; the relationship between the variables has to be studied further. Several authors have offered guidelines for the interpretation of a correlation coefficient. However, all such criteria are in some way arbitrary and should not be observed too strictly. When a strong correlation is expected between the variables then the coefficient are not absolute (Van der Velde 1996:50-51). As all loom weights are part of a loom, a high correlation may be expected between the different loom weights. Therefore a coefficient of 0.40 - 0.50 has to be regarded as pointing to only a slight relationship.

Results of the statistical analysis:
1. The correlation coefficient between the donut-shaped and the conical loom weights is 0.59. Conclusion: there is an interesting relationship between these types.
2. The correlation coefficient between the cylindrical and the wheel-shaped loom weights is 0.54. Conclusion: there is an interesting relationship.
3. The correlation coefficient between the wheel-shaped and the spherical loom weights is 0.40. Conclusion: There is a slight relationship.
4. The correlation coefficient between the conical and the beehive-shaped loom weight is 0.22. Conclusion: There is no relationship between the occurrences of these horizontally perforated types.

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[71] The strength of the linear association between two variables is quantified by the *correlation coefficient*.
Given a set of observations (x_1, y_1), (x_2,y_2), (x_n,y_n) the formula for computing the correlation coefficient is given by

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2]}}$$

Equation for correlation coefficient

The correlation coefficient (r) always takes a value between -1.0 and +1.0; with +1 or -1 indicating perfect correlation (all points would lie along a straight line in this case). A positive correlation indicates a positive association between the variables (increasing values in one variable correspond to increasing values in the other variable), while a negative correlation indicates a negative association between the variables (increasing values in one variable correspond to decreasing values in the other variable). A correlation value close to 0 indicates no association between the variables. Since the formula for calculating the correlation coefficient standardizes the variables, changes in scale or units of measurement will not affect its value. For this reason, the correlation coefficient is often more useful than a graphical depiction in determining the strength of the association between two variables. While correlation coefficients are normally reported as r = (a value between -1 and +1), squaring them makes then easier to understand. The square of the coefficient (or r square) is equal to the percent of the variation in one variable that is related to the variation in the other. After squaring r, ignore the decimal point. An r of .5 means 25% of the variation is related (.5 squared =.25). An r value of .7 means 49% of the variance is related (.7 squared = .49).

All in all there might be a relationship between the donut-shaped and conical loom weights, and between the cylindrical and wheel-shaped loom weights. Because the relationship is statistically very low (a correlation coefficient of no more than 0.59) further research can only be undertaken once larger numbers of various types of loom weights are available. The number of loom weights from Tell Mazar, Khirbet al-Mudayna and Tell er-Rumeith discussed in this volume are not sufficient to perform this kind of research.
Weaving experiments on a warp-weighted loom will make it possible to shed new light on the question concerning the different loom weight types used within a set of loom weights (see also Chapter 10).

The weight of the loom weights
The average weight of a loom weight in phase IX is 465.9 g.
The average weight of a set of loom weights used on a loom is 8 kg.

An average set of loom weights from Deir Alla consists of 28 loom weights. Within the different sets of loom weights, the variations in weight is surprisingly high, but no constant pattern could be found. Though very large loom weights were used, the average weight of a set of loom weights is always between 230-400 grams. Two different groups can be distinguished: five sets weighing between 230-330 grams (groups III, IV, V, VII and XIV); these may have been used to weave a lighter fabric of very thin wool, hemp or linen. Ten sets of loom weights were heavier, weighing 330-400 g; these may have been used to weave a heavier yarn.
In the literature, the weights used on one and the same loom are often supposed to be similar, but in reality differences are registered. Barber mentions the possibility that heavier weights were used at each end of a loom to strengthen the side selvedges (1991:96). Hoffmann records that sometimes two weights were tied to one bunch of threads to balance the shed, and that some weavers used much heavier weights tied to each end to strengthen the side selvedges, which get a lot of wear. She records differences of about 450 g between the weights in the middle of the loom and the last two for the selvedges (Hoffmann 1974:42,65). In Deir Alla this phenomenon was not traceable.

Extra-large loom weights
Some of the studied large groups contained extra-large weights.
A donut-shaped loom weight of 2400 g was found in group 2; its height is 10 cm, the diameter is 18 cm and the perforation has a diameter of 6.5 cm. The influence of this extra-large weight on the average weight of the donut-shaped loom weights is limited because the average weights of all 19 donut-shaped weights (the huge one included) is 335 g; without this big weight this figure would be 325 g. The average weight of the 33 loom weights in Group 2 is 379 g (ranging from 140-2400 g, the huge weight included); without the large weight it would be 307 g. An extra-large conical weight was found in group 7. It weighs 1550 g and has a height of 11.5 cm and a diameter of 13 cm; the diameter of the perforation is 3 cm. This conical weight shows signs of use inside the perforation. The loom weights in group VII have an average weight of 320 g, the huge loom weight included. Without this extra-large weight the average weight would be 201 g.
In group 14 a huge spherical weight was found, with a diameter of 16 cm and a height of 7.5 cm; the diameter of the perforation is 2.2 cm, and it weighed 1050 g.
The heaviest weight was found in group 15. This is a conical weight with a diameter of 14 cm and a height of 17 cm; the diameter of the perforation is 5 cm. It weighed 2740 g. The relationship between the outsized loom weights and the other weights from the same locus was studied but no special relationship could be found, neither concerning the weight nor the type. The weight of a loom weight and the size of the perforation may have a relationship to the threads that were used. Surprisingly, these parameters do not have a direct statistical relationship (the correlation coefficient is 0.48); therefore the conclusion must be that there is no meaningful relationship between the weight of a loom weight and the measurement of the perforation. To study the relationship between the weights in the various loci located within the same square, the correlation

coefficient between group 12 and group 13 was calculated. The result is a correlation coefficient of 0.08, which means that there is no statistical relationship between these two large groups of loom weights. All one can say is that different types of loom weights were used within one and the same household and on one and the same loom.

6.6 Conclusions

The study of the 589 loom weights from Deir Alla Phase IX has shown that research based on loom weights from sites with a great numbers of weights may yield interesting results. Only then can conclusions be drawn based on the average numbers. Such sites enable the research of complete and almost complete looms, and loom weights belonging to different looms within the same household can be identified and studied.

1) There appears to be no statistical correlation between the type and the number of loom weights used on the warp-weighted looms in Deir Alla. Nor did I find any special statistical relationship between the weights and the types used on the looms. In Deir Alla the average set of loom weights consists of 28 weights.

2) Wear in loom weights. The weights have been used for a long period of time; this is deductible from the traces of use which the threads occasionally left on the unfired weights (figs. 6.24 and 6.25). A detailed description of this phenomenon on the loom weights from Deir Alla can be found in Chapter 4.2 (fig. 4.13); see also Tell Mazar (Chapter 7.3, fig. 7.33) and Khirbet al-Mudayna (Chapter 8.3, figs. 8.29 and 8.30).

3) Traces of manufacturing in the loom weights of Tell Deir Alla were studied separately; see Chapter 4.2 and figs. 4.11 and 4.12.

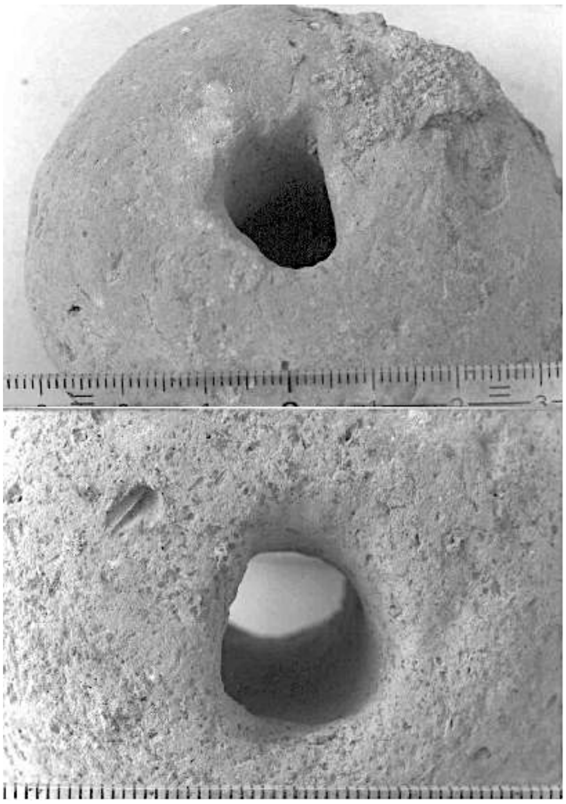

Fig. 6.24. Traces of use (wear) in loom weights.

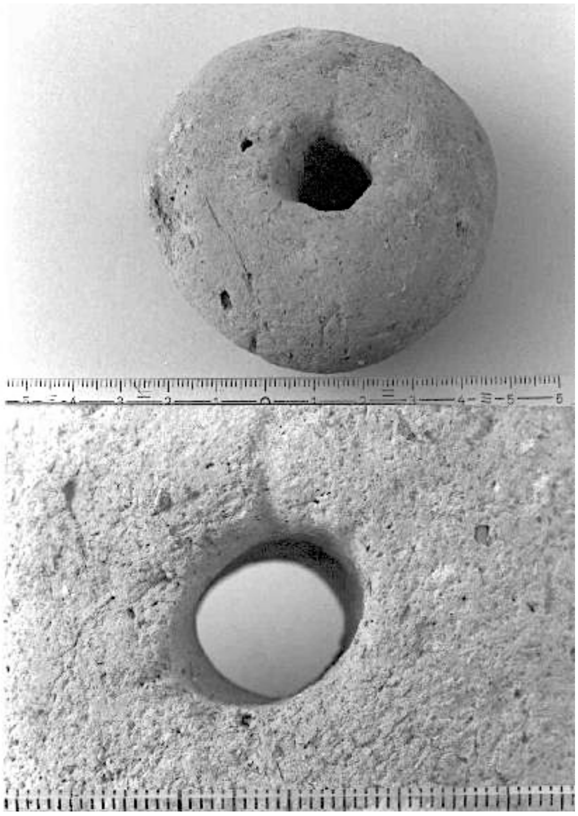
Fig. 6.25. Wear visible in loom weights. See also fig. 4.13.

4) Crowfoot (1951:29) and Browning (1988) suggest that there is a relationship between the form and the function of loom weights. In 2004, I concluded that no evidence for this idea was found in the collection of Tell Deir Alla because I did not find a statistical correlation between the different types of loom weights. My general conclusion then was: 'The type of a loom weight does not indicate the sort of textile produced but it might indicate a regional tradition for the manufacturing the loom weights.' (Boertien 2004:323). That conclusion can now be adjusted and refined.
The typology of loom weights has indeed a regional aspect that will be described below. But the conclusion that it is impossible to indicate which kind of textile was produced on the basis of the excavated loom weights appears to be wrong. From my study it can be concluded that the weight of loom weights does indeed indicate the thickness of the textile produced and it may also be an indication of the raw material used, either wool or linen/hemp. The influence of the thickness of loom weights on the cloth has been studied by weaving experiments performed at the Danish Centre for Textile Research (TTT Copenhagen), which ' ...show clearly that the thickness of a loom weight controls how closely threads of a particular diameter will be spaced in the fabric.' (Andersson Strand 2010:18). Now that more information is available on loom weights in general, as well as on modern experiments and analyses of textiles, I can say that the thickness of the loom weights may indicate the fineness of the cloth produced – see Chapter 10.4.
5) Cecchini describes the loom weights used during the Iron Ages in northern Syria in her publication on the textile industry of Tell Afis (Cecchini 2000). It is interesting to note that the types used in Iron Age Deir Alla show resemblance to the type of loom weights used in northern Syria. This concerns especially the use of spheroid loom weights together with donut-shaped weights, in combination with non-perforated reels/spools. Iron Age Afis yielded 59 loom weights, of which 13 are non-perforated reels (22%) and 46 are spheroid perforated loom weights (78%) (Cecchini 2000:222, 231-233). In Deir Alla 14.6% of the loom weights are spheroid in shape. This is a large percentage compared to other Iron Age II sites in the Southern Levant, such as Jerusalem where only 3% of the loom weights were spheroid (Shamir 1996:136). Kuntillet Ajrud yielded no spherical loom weights (Sheffer and Tidhar 1991:11), and in Tel Ta'anach only two of the 92 Iron Age loom weights were spheroid (Friend 1998:36-58). In Deir Alla one spool-shaped

loom weight was found, together with perforated weights in group 12. Possibly there were originally four of these weights, as three more lumps of crumbled clay were found made of the same fabric (see above).
Taking into account that the language used in the Balaam inscription shows influences from the north (Hoftijzer and Van der Kooij 1976; 1991; Van der Kooij and Ibrahim 1989:66), and that the grinding stones from Tell Deir Alla are imported from the north or north-east (Petit 1999:157), a northern influence in the loom weights is not surprising. In 2004 I wrote: 'But it seems too early to point into this direction, we will have to wait for more published material from Syria, and hopefully textile remains will be found and analyzed'. Since then more loom weights have been published and the picture has become clearer, as will be described in Chapter 10. Recently the first non-perforated loom weights were found in Transjordan, from Late Bronze Age levels at Tell Abu al-Kharaz (Fischer forthcoming 2013). The presence of non-perforated Iron Age IIB loom weights in Iron Age Deir Alla and the recent find of Late Bronze Age reel-shaped loom weights from Abu al-Kharaz, also situated in the Jordan Valley, can be regarded as a strong indication for a northern influence in the Jordan Valley.
6) In Iron Age Deir Alla the looms stood inside the houses, in the courtyard and on the roof.
Weaving could be performed at different places in or near the house. The warp-weighted loom needs a wall or a construction to lean against. To weave fine or patterned cloth a lot of light is needed. When the house is roofed, it is possible to work on the roof, and the courtyard seems to be a suitable place as well. However, the plan of phase IX shows that some looms stood inside a room (groups 1, 2, 5, 12 and 13). It is, of course, possible to weave inside the house if there are windows and/or door openings. In Iron Age Deir Alla some of the rooms had thin reed mats as roofing, and these rooms might have had enough light to work in (Van der Kooij 2002:70-71).
The excavated objects show that roofs were indeed used for setting up the loom. Several groups of loom weights were found amidst roof debris (groups 6, 7 and 9), and comparable situations have been described for Tel Batash (Browning 1988:133) and Jerusalem (Steiner 2001:100). Several groups of loom weights have also been found in the courtyard of the house, near the bread ovens (groups 10 and 11). Some of the loom weights seem to have been kept in storage, as they were found amongst storage jars (group 3).
7) Different types of loom weights were used on one and the same loom.
8) The loom weights that were found in situ at Deir Alla show that some looms had two rows of loom weights, indicating the production of a simple tabby weft. Other looms had three or four rows of loom weights, indicating uneven and even twill weaves, a kind of pattern weaving (see also Chapter 2). That patterns were woven is also confirmed by the spatulas that have been found, some of which were associated with the loom weights (see Chapter 3.2).
9) For whom were the textiles produced? Did the inhabitants of Deir Alla weave for their own households only or did they also produce for the market? Van der Kooij states: 'The fact that at the moment of the earthquake, only a few looms were in use, makes it possible that textiles were only made for home use when needed.' (Van der Kooij and Ibrahim 1989:88). However, because of the large number of loom weights found in the village of phase IX, this idea has to be rejected. When comparing the number of loom weights found in Deir Alla phase IX to other sites, the outcome is surprising. Browning (1988) counted 288 loom weights at Tel Batash (Timnah) (Israel map reference 1416.1325) and calls this a 'textile industry'. In Tell es-Saidiyeh, not far from Deir Alla, where 215 loom weights were excavated, Pritchard (1985:16-18 and 35-38) and Tubb (1985;1988;1998) wrote about production 'for own use'. See also Chapter 11.7 in which the architecture and function of Tell es-Saidiyeh is discussed.[72] In the City of David excavations in Jerusalem, 186 loom weights were found, 97 of which in one room in the *Bullae House*; Shamir calls this 'domestic weaving activity' rather than industrial production (1996:153). Kathleen Kenyon found 128 loom weights in Jerusalem in the debris on a street next to a building, and Steiner (2001:100) interpreted this as 'commercial production'.

[72] Burke (2010:166-167), who compares the plan of Tell es-Saidiyeh with that of Iron Age Gordion, concludes that the features excavated at Tell es-Saidiyeh show that textiles were produced in workshops resembling those at Gordion.

Deir Alla has yielded three times as many loom weights than most Iron Age sites in the Levant. At the moment of destruction of the village by the earthquake, at least 675 loom weights were present in the houses, on the roofs and in the courtyards. Given that an average of twenty-eight loom weights were used on every loom (see above), in Deir Alla at least 24 looms were in operation in the settlement (which has only been partly excavated). According to Van der Kooij and Ibrahim, the excavated part of the village was inhabited by fifteen households (1989:86-87). Thus the conclusion must be that more than one warp-weighted loom was used per household, 1.6 to be exact. It is possible that other techniques to make cloth were used as well, of which no archaeological traces have been left, such as weaving on the horizontal loom or card-weaving, which would make the amount of textiles produced in the village even larger.
In Deir Alla households had more than one loom, which means that the production of textile was an important economic factor in the community – see further Chapters 10.3 and 11. The fact that a special fibre (hemp) was made underlines this point. Tell Deir Alla is located in an agriculturally fertile environment on a trading crossroads. This location and the number of looms per household makes it reasonable to suggest that commercial production of textiles was undertaken, either for some form of exchange or for other uses.

To sum up, Deir Alla phase IX was an agricultural settlement where the inhabitants combined working in agriculture with textile production, both for their own use and for exchange. The village, situated at an important commercial crossroads, could have been part of a trading and exchange network in which textiles played an important role. The production of the special fine hempen cloth possibly strengthened the position of this small village within this network. The mode of production can be characterized as *household industry*, where production was undertaken by part-time professionals producing at the household level for group use or for a (local) market (Van der Leeuw 1977). Another possibility is that production was at the *workshop industry* level, whereby full-time professionals ran workshops producing for a wider region – see also Chapter 11.5. Considering the location of the benched room with a religious text written on the wall (the Balaam inscription) in the middle of the village, the production of textiles may also have been associated with a cultic use (see further Chapter 12).

Fig. 6.26. Donut shaped loom weights from Tell Deir Alla phase IX (98-7b-26).

6.7 Appendix: Growing fibre hemp in the Jordan Valley?The agricultural calendar of Iron Age Deir Alla

A fragment of hempen cloth has been excavated at Tell Deir Alla. The discovery of this textile fragment, as well as some small pieces of yarn made out of hemp, raised the question of whether the fibre hemp used to make these textiles could have been locally grown.
The most logical way to find an answer to this question seemed to be to look at the botanical remains, which have been investigated by Reinder Neef and published by Van der Kooij and Ibrahim (1989:30-38). However, when fibre hemp is used to make fine cloth, it is harvested before the setting of seed, so no hemp seeds can be expected in the botanical samples. To answer this question an alternative route had to be taken:

1. Would it have been possible to grow fibre hemp in the Jordan Valley?
2. Would growing fibre hemp have fitted into the agricultural activities of farmers living in Deir Alla in the Iron Ages?

To answer the first question it was necessary to investigate which conditions are needed to grow fibre hemp.[73] The soil conditions needed to grow fibre hemp were studied and compared to the soil conditions in the Jordan Valley. Information on the climatological circumstances such as temperature and rainfall in the Jordan Valley were studied.[74] To investigate whether growing fibre hemp would have fitted in the 'agenda' of the farmers of Iron Age Deir Alla, an agricultural calendar was drawn up for the Central Jordan Valley. The Deir Alla calendar is modelled on the Gezer Calendar and based on the botanical finds from Deir Alla phase IX.

Gezer Calendar

The Gezer Calendar (fig. 6.28) is an inscription found at Tell Gezer by R.A.S. Macalister in 1908. Lidzbarsky and Gray published the *editio princeps* in 1909. Many scholars have studied the text, trying to determine its purpose and date. The inscription has been attributed to the Iron Ages, with dates ranging from the 10th century BC (Albright 1943b; Cross and Freedman 1952:45) to the 8th century BC (Naveh 1987). The small limestone slab comprises a seven-line inscription and three letters at the lower left corner; the reverse side shows signs of an earlier inscription that was scraped off. Each line starts with the word *yrḥw*, which has been translated as *his two months* (Wright 1955:50-55) and as *the two months of* (Cross and Freedman 1952:46-47). The inscription lists agricultural activities for a twelve-month period. Because it is 'obviously a list of chores and not a calendar to tell the time', Borowski (2002:32) prefers the term *Gezer Manual* for this inscription. The language has been intensively discussed; it has been suggested that it is a northern Israelite Hebrew dialect (Cross and Freedman 1952:47; Borowski 2002:38, 43-44) or Hebrew/ Phoenician (Naveh 1987; 2009), while McCarter (2008:50-53) regards its language as an Old Canaanite script that preceded Phoenician, and relates it to the language used in the Tel Zayit Abecedary.

The text reads:
1. *yrḥw 'sp | yrḥw z*
2. *r' | yrḥw lqš*
3. *yrḥ 'ṣd pšt*
4. *yrḥ qṣr š'rm*
5. *yrḥ qṣr wkl*
6. *yrḥw zmr*
7. *yrḥ qṣ*
8. *'by* (Corner)

Translation (Naveh 1987)
1. two months of ingathering (of fruit/olives) two months
2. of sowing (cereals)/ two months of late sowing (legumes and vegetables)
3. a month of harvesting flax with a hoe[75]
4. a month of harvesting barley
5. a month of harvesting (wheat) and measuring (grains)[76]

[73] Agricultural information on growing fibre hemp was kindly supplied by farmers of the ecological farm *De Wenning* in the Netherlands.
[74] Derived from *The Global Historical Climatology Network* (http://www.worldclimate.com <17-10-2012>).
[75] Most scholars read the word as *pšt* and interpret the activity as *harvesting of flax with a hoe* after Wright 1955:50,53. Borowski (2002:34-38) suggests pšt has to be interpreted as *spread* and that it concerns spreading of weeds/wild plants which might be hoeing weeds (for hay). But his considerations on the harvesting of flax are based on flax grown for linseed production and not flax that is to be used in textile production has to be harvested early (before flowering).
[76] The reading of the third word in this line is controversial, most scholars distinguish only two letters preceding the *lamed xx l (x),* reading *waka[yi]l* translated as *harvest and festivity* (Albright 1943b:23; According to Borowski (2002:36) *harvesting and measuring* seems to be the right one, though Cassuto (1954:472) sees an extra illegible letters reading '*harvesting everything'* .

6. two months of grape harvesting[77]
7. a month of ingathering summer fruit [78]
8. …

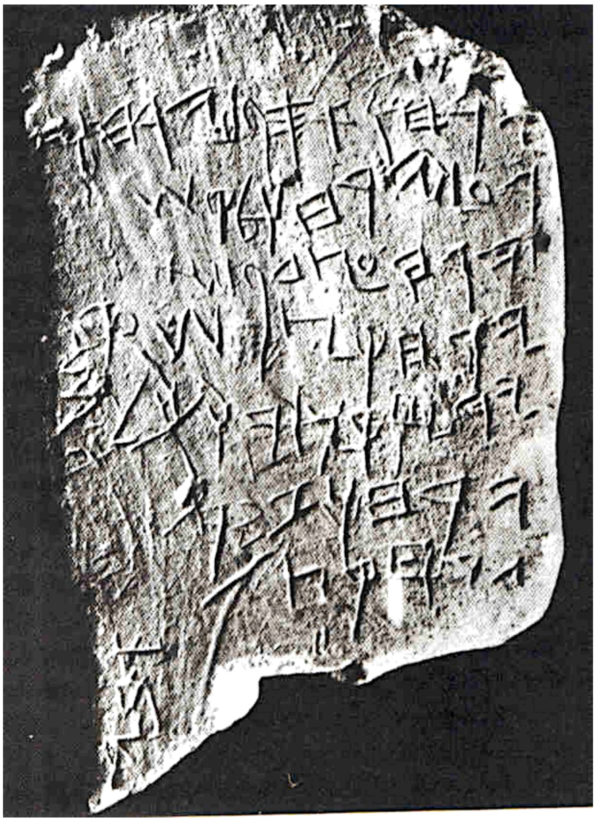

Fig. 6.28. Gezer Calendar.

The translation and agricultural interpretation of the text are mainly taken from Borowski (2002:32-38) and Wright (1955:50-55 with additional information in notes 9-12).

Cultivating fibre hemp

Hemp used for fibre production is sown densely so that growth produces tall slender stems with small bast cells. Plants are harvested when the stalks are about 2 meters tall, 2.5 months after sowing, that is after flowering but before the seeds set (Riddlestone 1996). Hemp is a desirable crop to grow because it gives high production per hectare and requires minimal attention. It not only requires no weeding, but also kills off all the weeds, and it is mildew resistant. The crop has been subject to intensive breeding programmes in several European countries. Fibre hemp responds well to all favourable growing conditions. The critical element is to make sure to seed into moisture. Hemp has a high demand for water at certain stages of its development. The highest quality of fibre appears to be present at the time of early flowering. Early cultivars mature to seed in 120-150 days. A yield of 300-400 kg/ha would represent a good experience for a first-time grower. This information is taken from present organic agriculture.[79] It is known that about 200 m2 of land is needed to grow flax to produce 30 kg of linen yarn (Anderson Strand 2010:11-12).[80] Generally speaking these figures can also be applied to the cultivation of hemp.

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[77] According to Borowski 2002:36 contra Wright 1955:54.
[78] Ingathering of summer fruit can be regarded as gathering fruits from trees such as figs and pomegranates (Borowski 2002:38).
[79] Organic agriculture in the United States (Oregon State University), Canada (Agriculture and Agri-Food Government of Canada) and the Netherlands (De Wenning, Hennepdoolhof en Ecologisch Bedrijf, Orvelte. http://hempflax.com/over-hempflax/teelt-van-hennep).
[80] 100 m2 gives about c.25 kg of different qualities of yarn. 25 kg yarn is 287,500 m of thread.

Soil conditions
Different tests have shown that hemp can be grown on very different kinds of soil; fertile clay loam or silt loam soils, neutral or slightly alkaline, are best for hemp. The plants grow very fast, sometimes even 50 cm a week, acquiring a total height of 3 meters. The total biomass is 12.4 t/ha for unfertilized material. Under dry conditions the total height is less than it is in the black soil, about 1.5 m only, but sufficient to be used in textile production. The total biomass production is 6.8 t/ha on unfertilized dry land fields. The results (table 6.17) indicate that the crop needs substantial moisture, the onset of drought conditions severely restrict biomass production.[81]

Date	Height	Air-dried biomass (t/ha)
June 15-plant	0	0
July 18	28.5	6.5
July 24	45.8	11.1
August 7	96.3	20.1
August 21	104.2	16.4
September 3	101.1	9.8
September 19	101.7	11.5
October 2	106.5	12.5

Table 6.17. Fibre hemp heights (cm) achieved on dark brown soil in 1996 (Van der Werf and Turunen 2008).

Climatic conditions
The Deir Alla climatic data (moisture and temperature in table 6.18) are derived from The Global Historical Climatology Network, version 2 Beta.[82] The need for moisture at the early stages makes it necessary for hemp in the Southern Levant to be sown early, that is in December or January.
Growing fibre hemp in the Jordan Valley is possible without irrigation, but with irrigation the production will be higher. Eva Kaptijn has shown that communities living in the Jordan Valley used irrigation in the Iron Age (2009:322-325). The climatic and soil conditions of the central Jordan Valley show that hemp cultivation is indeed possible. Hemp as a dual-use crop: the seed can be used for oil production and the fibre can be utilized for other purposes, giving a raw and weak hemp fibre that cannot to be used in textile production. When hemp is grown to be used in fine textiles (such as the excavated textile) the plants would have to be cut while flowering, before the setting of seed, that is most likely before the dry season in March or April.

From fibre to yarn
Hemp fibres come from the bast cells that provide support for the stem. The processing of fibre hemp to yarn requiring retting of the stalks. Retting is a microbial process which breaks the chemical bonds that hold the bast fibre bundles together. Since it is a biological process, retting requires both moisture and temperatures warm enough for microbial action to occur. When cultivating and processing hemp, retting of the stalks can be done in two different ways depending on the climatic conditions. Hemp can be left to ret in the fields, if there is enough rain. When the weather conditions are dry hemp is harvested dry and retting has to take place somewhere else. The weather must also be dry enough once retting is completed to allow sufficient desiccation so that the stalks can be baled and stored. In the Jordan Valley precipitation drops fast in spring (see calendar table 6.18), retting in the fields would only have been possible if hemp was harvested in March; if the hemp was harvested in April or even later, the humidity would have been too low to leave the hemp to ret in the fields. The hemp stalks would have to have been harvested and

[81] Oregon State University OSU http://extension.oregonstate.edu/catalog/html/sb/sb681/ (<22-10-2012>.
[82] The Deir Alla climatic data are based on current information from the Weather Station Deir Alla (32.20°N 35.60°E. Height about -224m above sea level). Source: Deir Alla data derived from GHCN 2 Beta (= The Global Historical Climatology Network, version 2 beta) 343 months between 1952 and 1980. (http://www.worldclimate.com <17-10-2012>)

brought to a place where controlled retting (regularly adding water to the stalks) could take place, probably in or near the village.

Agricultural Calendar

Browning (1988) designed an agricultural calendar for Timnah/Tel Batash based on the Gezer Calendar that was found in the same region. He inspired me to create an agricultural calendar for the Jordan Valley in the Iron Age. The Gezer Calendar (fig. 6.28) is an Iron Age inscription that documents the organization of the agricultural year (see above). The text of the Gezer Calendar demonstrates that flax was cultivated and harvested, but hemp is not mentioned. To investigate whether hemp could have been cultivated in the Jordan Valley, which is so famous for the production of flax (see Chapter 2), I studied literature on botanical remains from Iron Age Deir Alla (Van der Kooij and Ibrahim (1989:30-38), agriculture in the Iron Ages (Borowski 2002) and the cultivation of flax and hemp used for textile production (Forbes 1956). In Egypt the flax harvest preceded the wheat harvest (Forbes 1956:27-30); the Gezer calendar mentions that the harvesting of seed-forming flax was in June. Flax used to make linen was harvested before flowering, in April (see also Chapter 2). According to Zohary (in Borowski 2002:35) flax can be harvested in the Jordan Valley in Adar, which is as early as March/beginning of April. Early harvesting of fibre hemp in March would have been profitable because the harvested stalks could have been left in the fields for retting. Retting in the fields is possible in early spring because then there is still 45.6 mm of rain. If harvesting was undertaken in April, it would not have been possible to leave the stalks in the fields to ret because that period is much dryer (17.3 mm of rain).

February	***March***	***April***	***May***	***June / July***	***August***
53.3 mm	*45.6 mm (late rain)*	*17.3 mm*	*3.3 mm*	*0.0 mm*	*0.0 mm*
16.0 °C	*18.3 °C*	*22.2 °C*	*26.3 °C*	*29.2 - 31.1 °C*	*31.0 °C*
weeding preparing the land for late seeding	late seeding and weeding **(harvesting fibre-hemp followed by retting in the field)**	**harvesting flax** **(harvesting fibre-hemp)** harvesting lentil and chickpea shearing the sheep	**harvesting seed-hemp** harvesting barley and wheat harvesting lentil and chickpea shearing the sheep	harvesting figs, dates, sesame **harvesting linseed-flax (harvesting seed-hemp)** 'measuring'	grapevine harvest
September	***October***	***November***	***December***	***-------------***	***January***
0.2 mm	*8.0 mm*	*34.7 mm (early rain)*	*52.6 mm*	---	*61.3 mm*
29.7 °C	*26.8 °C*	*21.7 °C*	*15.8 °C*	---	*14.6 °C*
harvesting summer fruits such as pomegranates and olives	harvesting summer fruits such as olives	harvesting olives and pressing oil preparing the land for seeding	**sowing flax** **(sowing fibre-hemp)**		sowing and weeding **(sowing fibre-hemp)**

Table 6.18. Deir Alla agricultural calendar. Temperature and precipitation given in monthly averages[83].

[83] Deir Alla climatic data derived from *The Global Historical Climatology Network*, (version 2 beta); 343 months between 1952 and 1980. (http://www.worldclimate.com <17-10-2012>).

Archaeological remains
In Deir Alla phase IX, a fragment of hempen cloth was found together with the loom weights. The cloth has been analyzed using a Scanning Electron Microscope, which showed that it had never been used. This proved that the cloth was found amidst the loom weights of the loom on which it was woven. Some threads from inside the loom weights were analyzed and they also appeared to be made of fibre hemp. From these finds it can be concluded that fibre hemp was used and hempen cloth was produced at the site.
Some other finds from phase IX may also point to the production of fibre hemp at the site. Several pounding installations have been found, one of which was situated in B/A8 (Van der Kooij 2002). Hemp and also flax, have to be pounded and beaten to make the fibre from the stalks usable; this process is called *decortication*, see Chapter 2. It is possible that the pounding installations were used for the decortication of hemp or flax.
Loom weight group 9 (B/C8 locus 75) was found together with plant material (see above 6.4 and fig. 6.15) in a storage room with a pavement of cobbles; the plant material has not yet been analyzed, it might be some kind of vegetable fibre to be used for spinning and/or weaving. According to Van der Kooij, Deir Alla phase IX yielded large amounts of plant material, found at various places within the settlement (2002). Van der Kooij interpreted this as *fodder*. He describes one of these finds as consisting of plant material found on a cobbled floor in an unroofed area (B/C7 nr III) (see fig. 6.15). Plant material stored on a cobbled floor seems to be unusual, and that plant material might have been something more valuable than fodder. Storage of hemp stalks could be an explanation for the large amounts of *fodder* found in phase IX.

Conclusions
The *Deir Alla agricultural calendar* shows when the various activities were undertaken and it proves that the cultivation of hemp is possible within the calendar of the agricultural year. The agricultural, soil and climatic conditions are suitable to grow fibre hemp in the Jordan Valley. The finds of a piece of fine cloth made of fibre hemp (Chapter 6.2; Vogelsang-Eastwood 1998; Boertien 2004) and some remnants of vegetal material in contexts where such material is not normally found, as well as the pounding installations, indicate that the hempen cloth excavated in Deir Alla phase IX (dated to c. 800 BC) could have been produced at the site itself from hemp cultivated near the village. Pollen from Cannabinaceae is carried by the wind and can be found in the sediments on the bottoms of lakes and ponds located near the place of cultivation. Future pollen studies would perhaps enable us to substantiate the hypothesis that fibre hemp was cultivated in the Jordan Valley during the Iron Ages.

Chapter 7 Study of excavated remains: Tell Mazar

7.1 Introduction

Tell Mazar is situated in the Central Jordan Valley, 3 km east of the river Jordan, between Wadi Rajib (1.5 km) and the Zerqa river (map 1.1; 6.1 and 7.1), (Pal. Grid coordinates 2073.745-1810.728; UTMG coordinates 7214.280; 563.314). The site consists of a main tell measuring 160 x 140 m and rising to a height of 24 m above the surrounding plain, The University of Jordan conducted four seasons of excavations from 1977 to 1981, directed by Dr Khair Yassine (Yassine 1988; Yassine and Van der Steen 2012). A smaller mound (Mazar Mound A) to the northwest yielded an open court sanctuary and a cemetery (Yassine 1984a; 1984b; Yassine and Van der Steen 2012:17-24).

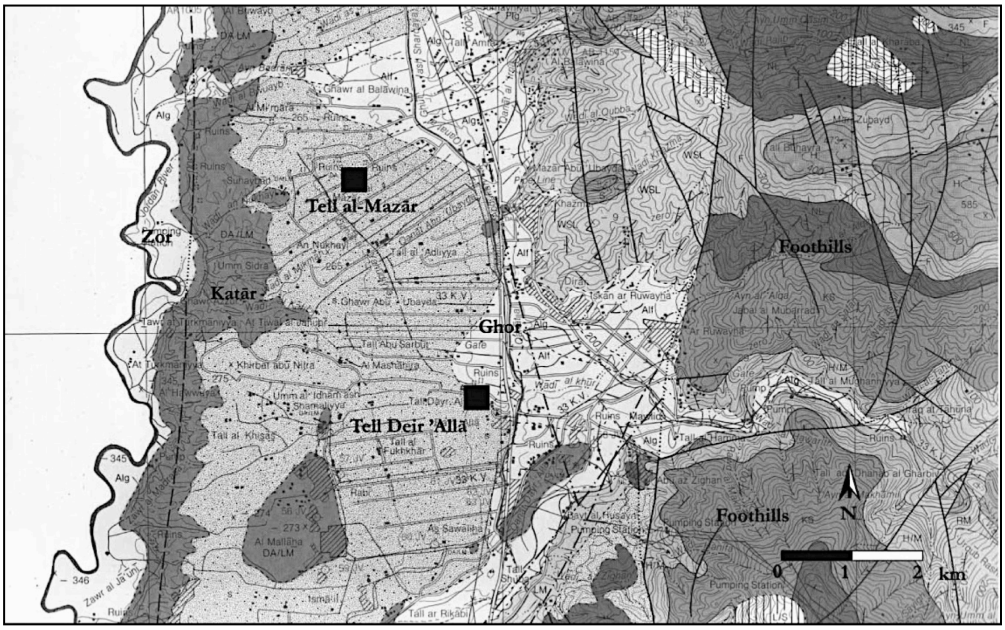
Tell Mazar was occupied since the Middle Bronze Age, judging from the pottery that was found on the surface (Yassine and Van der Steen 2012:5). The mound contained occupation layers from the Late Bronze Age II,[84] into the Hellenistic period. The open court sanctuary at Mound A dated to the 11th - 10th century BC (Iron Age I) (Yassine 1984a:108-118; 1988:115-126: Yassine and Van der Steen 2012:17), while a cemetery was found from the Persian period (Yassine 1984b). The excavations on the tell itself unearthed an area (1) of 30x35 m published by Yassine and Van der Steen 2012; another area (2) on the south slope of the tell of 30x25 m has not been published.

This chapter deals with the loom weights from Area I, dated from Iron Age II into the Early Hellenistic Period, found in five sequential occupation layers. Yassine published a dating of the various strata in 1988, and in 2012 Yassine and Van der Steen published the final study of the stratigraphy and pottery of Tell Mazar. Tell Mazar is the only site in Jordan where loom weights could be studied from the Iron Age into the Early Hellenistic period. This offered me the opportunity to design a typology of loom weights from Transjordan.

Tell Mazar is situated in an area where several sites that date to the same period are located: the Iron II period. To the north lie Tell Ghazaleh, Tell Ammata on the river Rajib (Petit *et al.* 2006:182; Petit 2009) and Tell es-Saidiyeh (Pritchard 1985); to the south: Tell Adliyeh (Petit 2006:183; Petit 2009), Tell Deir Alla (Van der Kooij and Ibrahim 1989; Van der Kooij 2001; Boertien 2004), Tell Damiyah (Petit *et al.* 2006:185-187; Petit 2009); and along the river Zerqa to the east Tell el-Hammeh (Van der Steen 1998; 2001; Veldhuijzen and Van der Steen 1999; 2000; Veldhuijzen 2005; 2006; Petit 2009:171-172; Kafafi and Van der Kooij 2010).

The southern part of the Central Jordan Valley has recently been surveyed by the Deir Alla Regional Project (Petit *et al.* 2006; Petit 2009; Kaptijn 2010). The preliminary results provide new information on the settlement history of the Jordan Valley between Wadi Rajib and the river Zerqa. Tell Mazar is not situated near the Zerqa, the Wadi Rajib, or even the Wadi al-Ghur. From the Late Bronze Age onwards, none of the sites mentioned above were situated directly on a perennial water source (Petit *et al.* 2005:180), suggesting the presence of some kind of irrigation system. In 1988 Yassine wrote about the water source of Tell Mazar: '...the steady stream driven from the Zerqa River. Old maps show that several canals were driven from the Zerqa River, north along the foothills, then turning west, passing the tell on the north side, with one canal at the south side.' (Yassine 1988:76).

[84] The unpublished areas P and Q.



Map 7.1. Geological map of the Central Jordan Valley (Muneizel and Khalil 1993).

History, strata and dating

Texts and seals excavated at Tell Mazar made it possible to draw a historical framework for the different strata. Yassine excavated and published seven ink inscriptions from different strata (Yassine and Teixidor 1988:137-142). The texts are written in the Ammonite version of Aramaic. The seals (Yassine 1988:143-155) show a Neo-Babylonian / Persian influence, and local Ammonite elements are visible in the iconography and in the names. The seals from the tell were published as *Ammonite Seals from Tell el-Mazar,* and according to Yassine (1988:143) the seals 'belonged to the occupants of 7th -5th century BC', that is, the strata V, IV, III and II. In the following description of the strata I have used contemporaneous texts from other parts of the Middle East mentioning kings and the situation in Ammon to sketch the historical background.

Stratum VI (Iron Age IIB, 8th century BC)

Stratum VI consists in fact of several strata. Loci from this stratum have been excavated in only a few small areas. Since they could not be connected, all features are called Stratum VI (Yassine and Van der Steen 2012:5). The earliest excavated features consisted of different walls that formed part of a building showing a north-south orientation. In the northeast corner a slab stone pavement was excavated. The building was destroyed. The Assyrian annals mention how in this period twelve kings rose against Nineveh and were slaughtered by Shalmaneser III, one of which was Baasa, son of Ruhubi, the king of Ammon, (858-824 BC) (ANET:279).

Stratum V (Iron Age IIB/C, 8th -7th century BC)

This stratum was situated in the same area on top of Stratum VI. The oldest stratum for which a meaningful architectural context could be reconstructed was Stratum V. Stratum V consisted of a building with a square courtyard, the floor of which was paved with flagstones, surrounded by rooms. One of the rooms yielded several storage jars, filled with wheat and 56 loom weights (group 1); the loom weights were found in the southeastern corner of the room (fig. 7.1). On the field photographs (Yassine 1988:100-101, pl.VII, pl.VIII2) the loom weights are shown in situ, with three (or more) rows of loom weights to the south of the *bathtub construction* (see below), together with broken pottery. According to Yassine (1988:110), in the northwestern part of the stratum a beer jug decorated with the relief of the goddess Astarte was found (Hunziger-Rodewald 2012:47-48).

It has been assumed that the settlement of the 8th century BC was a centre for a complex administration. It is likely that Transjordan had become part of the territory of Damascus in 732 BC, together with Galilee. According to the Assyrian sources, the Transjordanian states submitted to Tiglath Pileser III (745-727 BC) after his campaign in 734-732 BC (Vera Chamaza 2005:127-132; Tadmor 2007:186). The kingdoms/chiefdoms of Transjordan are explicitly mentioned in the Assyrian tribute lists of Tiglath Pileser III (744-727 BC) as bringing: '...linen garments with multi-coloured trimmings, garments of their native industries made of dark purple wool...' from the kings of the Southern Levant, including Sanipu of Bit Ammon, Salamanu of Moab, Mitinti of Ashkelon, Jehoahaz of Judah, Qashmalaku of Edom and Hanno of Gaza (Tadmor and Yamada 2011: 122; ANET 282).[85] In addition to political problems, the region was suffering from the after-effects of a devastating earthquake. According to Petit (2006:186-187), several settlements in the region, such as Tell Deir Alla, Pella, Tell Abu al-Kharaz and Tell Damiyah, show evidence of a severe earthquake in the layers dated to about 800 BC.

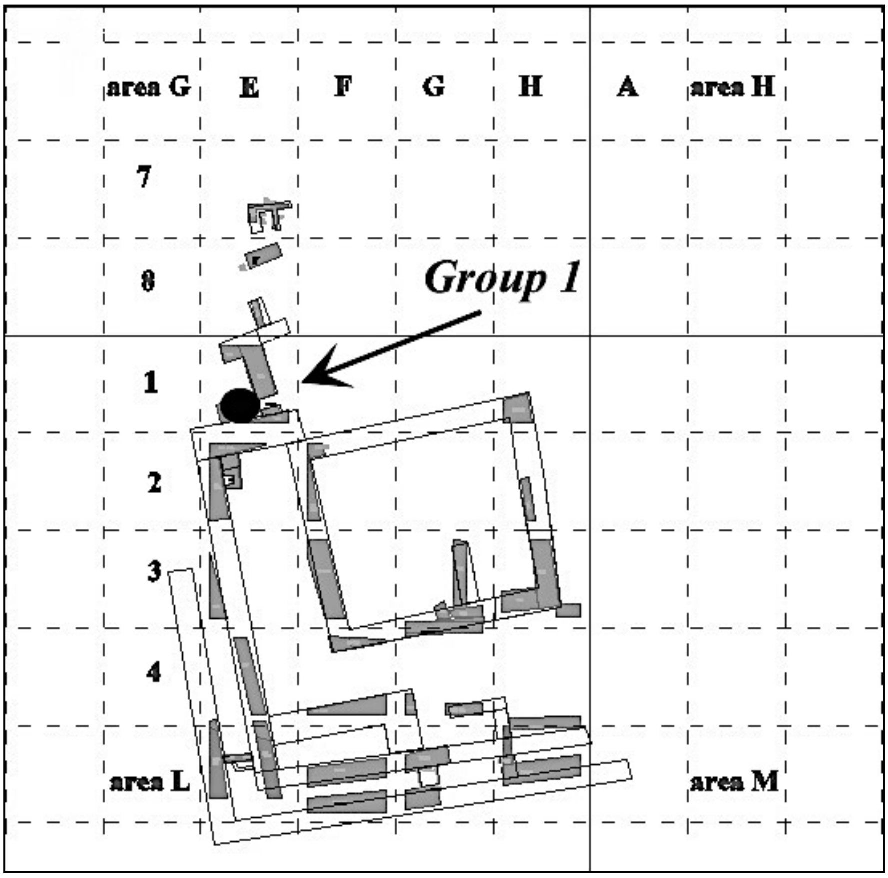


Fig. 7.1. Plan of Tell Mazar Stratum V showing the location where the loom weights of group 1 were found (courtesy of E. van der Steen).

Only in the middle of the 8th century does the region seem to have recovered from these difficulties. In this period the pottery of the Central Jordan Valley shows Neo-Assyrian influences, as shown at Tell Deir Alla, Tell Adliyeh, Tell es-Saidiyeh and at Tell Damiyah. According to Yassine, Assyrian influences were visible in the pottery finds of Tell Mazar as well (1988:84-85). The excavated settlements in the Central Jordan valley indicate that this was a period of prosperity. There were villages that were engaged in agriculture (Tell Deir Alla), settlements with a more public or political function (Tell Damiyah and Tell Mazar) and sites that were simply in use as a seasonal camp (Tell Ammata). According to Petit, the region seems to have been part of a larger

85 In the later tribute lists of Senacherib 704-681 BC (ANET 287) and Esarhaddon 680-669 BC, no textiles from Transjordan are mentioned (Leichty 2011:46 ANET 291).

polity, possibly as a result of the Neo-Assyrian hegemony, in which not Tell Mazar but Tell Damiyah was the Neo-Assyrian centre because it was situated strategically near the ford across the river Jordan on the east-west road leading to Cisjordan (Petit 2009:226). The settlement of Stratum V ended at the beginning of the 7th Century BC in a severe conflagration.[86]

Stratum IV (Iron Age IIC, 7th century BC)
This stratum represents an earlier stage of the 'Palace Fort' of Stratum III. The nature of the settlement seemed to have been non-military. There is no evidence of destruction or conflagration at the end of this phase. The settlement underwent some changes and rebuilding. No loom weights have been found in this stratum.

Stratum III (Iron Age IIC, 7th - 6th century BC)
In Stratum III a large structure of massive proportions was built in the centre of the mound. The elaborate building has been characterized as a palace and the excavators called it the 'Palace Fort'. Petit concludes that the late 7th-6th century BC archaeologically left hardly any traces of occupation in the region, suggesting a more nomadic lifestyle of the inhabitants (Petit 2006:187). This, however, does not agree with the large building found at Tell Mazar.

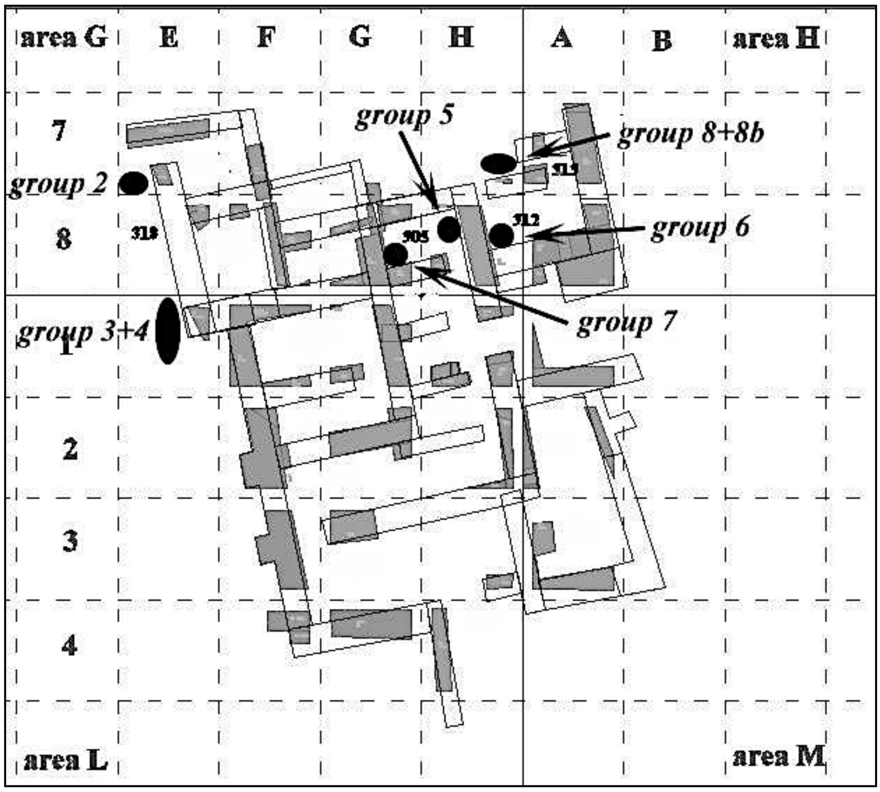


Fig. 7.2. Plan of Tell Mazar Stratum III (courtesy of E. van der Steen) the dots and group numbers show the places where large groups of loom weights have been found.

According to Yassine, in the 7th century BC Tell Mazar was probably built as a garrison city by an Ammonite king. It was the central residence of the governor of this area, and as such it served as an Ammonite administration centre (Yassine 1988:85). Some inscriptions have been found in this stratum that can be used as an indication for the historical framework: Locus LH3:6 yielded three ostraca (JUM[87] 223/79, JUM 224/79 and JUM 225/79), which were found with others sherds on floor 10. F.M. Cross dated the texts to the early 6th century BC (Yassine and Teixidor 1988:139). During the reign of Ashurbanipal (668-633 BC), Assyrian records mention the growing pressure of

[86] Yassine (1988: 92) assigned the destruction of this stratum to the campaign of Sennacherib in 701 BC.
[87] JUM=Jordan University Mazar.

the desert tribes along the borders, among which Ammon and Moab are listed. Assyria therefore fortified the desert frontier and protected the caravan routes. Aminadbi, king of Beth-Ammon, is mentioned in the account on the first campaign of Ashurbanipal against Egypt (667 BC) as one of the 22 kings who brought gifts and kissed his feet (ANET:294).
Seven groups of loom weights were found in the northern part of the building (fig. 7.2). The occupation of the Palace Fort came to an end when the whole building was set alight. The destruction of Tell Mazar must have occurred before the end of the 6th century BC.[88] Thick burned debris layers from this period were also encountered at Tell Deir Alla phase VI, Tell Adliyeh phase 15 and Tell Ammata phase 9 (Petit 2009:227). The fire has been associated with Nebukadnezar's expedition into Ammon in 582 BC (Yassine1988:88; Yassine and Van der Steen 20121:2).

Stratum II (Persian Period, 5th - 4th century BC)
This stratum extended over the entire excavated area. The beginning of this period is marked by a massive filling operation designed to cover and level off piles of debris and stumps of walls. The buildings of Stratum II are private houses built along two sides of a central open courtyard (fig. 7.3). The finds revealed official stamps and stamp impressions (Yassine 1988:143-155), metal objects, bronze and silver jewellery and bronze fittings, all dating to the Persian Period. According to Yassine and Van der Steen the site was abandoned at the time of Alexander the Great (333 BC) (Yassine 1988:81-84; Yassine and Van der Steen 2012:15).

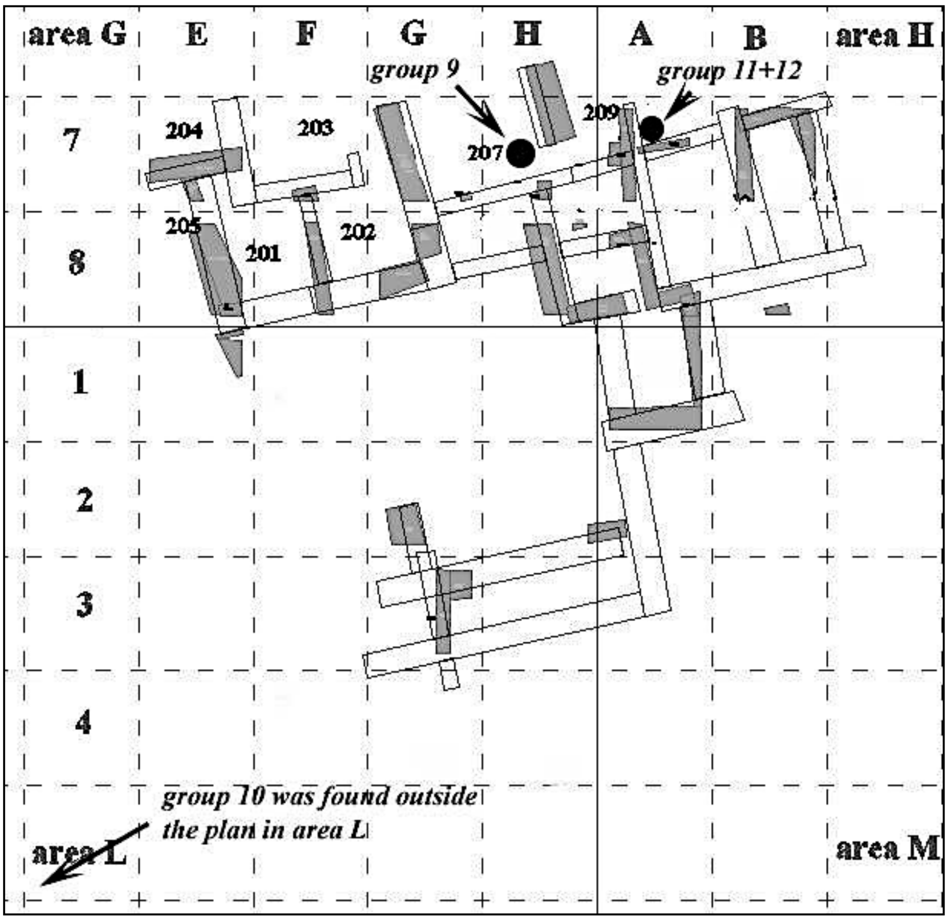


Fig. 7.3. Plan of Tell Mazar Stratum II (courtesy of E. van der Steen).

Ostracon JUM 222/79 was found in a broken silo with a mixed assemblage of pottery sherds from the Persian and the Early Hellenistic periods (locus MA2:6). The text of nine lines consists of a list

[88] At the beginning of the 6th century BC, during the reign of the Neo-Babylonian king Nebukadnezar, Ammon became a Babylonian province.

of personal names. The script is dated to the 5th century BC. Some of the names are conspicuous, such as *mlqmyt* in which the name Milcom can be read, *hsl'l* according to Yassine is the name of the Ammonite king Hazael (*c.*620 BC), and the name *yqm*[']*l* also known from the Arad ostraca (Yassine and Teixidor 1988:140-141; figs. 8 and 9). Three groups of loom weights were found in area G and one in area L (fig. 7.3).

Stratum I (Early *Hellenistic period, 4th century BC*)
This is the uppermost stratum at Tell Mazar, characterized by dozens of round storage pits and silos. The artefacts recovered from inside these pits have been dated to the Early Hellenistic period. During the Hellenistic period people used the summits of existing tells only for keeping their animals (Petit 2006:179-180). But the finds from this stratum do indicate some kind of inhabitation of the site in the Hellenistic period. Two inscriptions were excavated in this stratum, both from locus HA7:7: ostraca JUM 142/78 and JUM 27/78. The script of both ostraca has been dated to the Early Hellenistic period (4th century BC) (Yassine and Teixidor 1988:137-139). Two groups of loom weights were found in the northern part of area G (Yassine 1988:82 fig. 3): group 13 was found in HB7 and group 14 in HD1.

7.2 Objects associated with textile production

Some of the objects used for textile production excavated at Tell Mazar had already been depicted in Yassine's publication of 1988. When first seeing the spatulas (Plate XIII), the alabaster loom weight (Plate XVII:1, now exhibited in the University of Jordan Archaeological Museum in Amman) and especially Plate XVIII with so many different types of loom weights, I hoped to once have the chance to compare them to the finds from Tell Deir Alla. When Eveline Van der Steen asked me to study the material from Tell Mazar I was glad to be allowed to study the loom weights; the spindle whorls, spindles, needles and spatulas could not be studied yet. Yassine and Van der Steen have published some of these artefacts in the catalogue to their publication (2012:56-162). Hopefully it will be possible to study this material in future research.

7.3 The loom weights

More than 550 loom weights have been excavated at Tell Mazar. From the artefact lists it is clear that the actual number of excavated loom weights must have been even greater. The 550 loom weights kept in storage at the University of Jordan were very well preserved (impregnated). Of these, 543 loom weights could be studied; seven loom weights were not labelled and therefore could not be studied. It was possible to distinguish 14 separate large groups of loom weights (each of more than 10 weights),[89] each belonging to one loom. The 14 large groups represent 71.8 % (390) of all the excavated loom weights at Tell Mazar. The average weight of a loom weight from Tell Mazar is 362 g. The average number of loom weights in a group, taken over all strata, is 31, with the average total weight of a group 16,066 g. At Tell Mazar 49 loom weights were of a hybrid type; these weights were categorized as of *mixed type* (chapter 3) and most of them were found within the groups discussed below.

[89] The number of ten weights to a large group is based on the fact that this is the minimum number that makes weaving on a warp-weighted loom possible (see Chapter 4.1).

Types of loom weights

The loom weights of Mazar are from different strata, diachronically representing the Iron Ages down to the Early Hellenistic Period.

Stratum	Period	Average perforation/cm	Average weight/grams	Number
VI	Iron Age IIB 8^{th} century BC	1.5	287	n= 5
V	Iron Age IIB/IIC 8^{th} -7^{th} century BC	1.4	132	n= 56
IV	Iron Age IIC 7^{th} century BC	--	--	--
III	Iron Age IIC 7^{th-} -6^{th} century BC	1.6	547	n=180
II	Persian period 5^{th} century BC	0.9	106	n=179
I	Early Hellenistic Period 4^{th} century BC	0.4	40	n= 82

Table 7.1. Loom weights Tell Mazar by stratum (41 unstratified). N= 543.

Iron Age loom weights

Iron Age loom weights are relatively heavy. In Strata VI and V mainly donut-shaped and spherical loom weights have been found, together with some cylindrical weights. The average perforation diameter is about 1.5 cm. In Stratum III anchor-shaped loom weights appear and were used as often as the donut-shaped loom weights. Conical and cylindrical weights were used together with heavy wheel-shaped loom weights. The average perforation diameter is 1.5 cm. In Stratum II the pyramidal loom weight appears for the first time. The anchor and donut-shaped loom weights are still being used, as well as small spherical weights. Hardly any conical or cylindrical weights were found. In this stratum, dated to the Persian period, the loom weights tend to be smaller and lighter than those of the earlier Iron Ages. The average perforation diameter decreases to less than 1 cm. The average weight of the loom weights in strata V and VI is 210 g. However, in Stratum VI only five weights have been found, therefore I consider the average weight of the loom weights from Stratum VI as unrepresentative. Stratum V yielded one coherent group of 56 loom weights, these are all supposed to belong to the same loom (see below), and their average weight is 132 g. Many more loom weights were found in Stratum III, with a higher average weight: 547g. In Stratum II some heavy anchor-shaped weights (427 g) were used together with medium-sized donut and spherical loom weights, and a new type was introduced: the lighter pyramidal loom weights (147 g), the average weight of all Stratum II loom weights is 126 g.

Fig. 7.4. Two cylindrical loom weights (left and right), a wheel-shaped loom weight (second from right), a mixed type loom weight (cylindrical/wheel-shaped) (second from left) and a donut-shaped loom weight in the middle (from Area L square H 1:7).

Fig. 7.5. Anchor-shaped loom weights group 8 (HA7:4).

The Early Hellenistic loom weights

The loom weights from this period differ in many respects from those used in the Iron Ages. Stratum I, dated to the Early Hellenistic period, sees the introduction of small, almost miniature loom weights. The types are mainly donut-shaped, pyramidal and spherical, with a small perforation diameter of less than 0.5 cm. These small and light weights, with their tiny holes, suggest a different technique of weaving or a change of material woven on the warp-weighted loom. Stratum I yielded 82 small loom weights, with an average weight of 40 g. These loom weights are often pyramidal with a square base. Spherical and donut-shaped weights are still in use, but smaller and lighter ones than in the earlier periods, with tiny holes of less than 0.5 cm.

Type	Number	Percentage
Anchor-shaped	117	21.6 %
Conical	30	5.5 %
Cylindrical	31	5.7 %
Donut-shaped	146 (23 large)	27 %
Mixed type	49	9 %
Pyramidal	33	6 %
Spherical	112	20.6 %
Square	15	2.8 %
Wheel-shaped	10	1.8 %
Total	*543*	*100 %*

Table 7.2: The loom weights of Tell Mazar by type (n=543).

Type	Stratum VI n=5	Stratum V n=56	Stratum III n=180	Stratum II n=179	Stratum I n=82	Unstratified n=41
Anchor-shaped (n=117)	0	0	45	71	1	0
Conical (n=30)	1	0	25	2	2	0
Cylindrical (n= 31)	0	1	18	3	0	9
Donut-shaped (n=146)	2	21	54	28	9	32
Mixed type (n=49)	0	0	22	1	26	0
Pyramidal (n=33)	0	0	0	24	9	0
Spherical (n=112)	2	33	7	35	35	0
Square (n=15)	0	0	0	15	0	0
Wheel-shaped (n=10)	0	1	9	0	0	0
Av. Weight (g)	*287*	*132*	*547*	*106*	*40*	--

Table 7.3. Loom weights of Tell Mazar: Number and type within the different strata (n=543).

Material

Most of the loom weights from the Southern Levant were made of clay, but at Tell Mazar other kinds of material were also used to make loom weights. All the loom weights have been analyzed using a magnifying glass and a microscope (magnification 10x).

Clay

Most of the loom weights from Tell Mazar were made of unfired clay. The clay was local, probably the banded clay from the Lisan/Damiyah formation that was also used for the Tell Deir Alla loom weights (Chapter 6; Boertien 2009).[90] Groot (2007:100) defined three types of fabric in his analysis of the pottery of Deir Alla, of which types 1 and 3 were also found in the loom weights. Fabric 1 is used in 5 of the 14 groups of loom weights. It is characterized by a high percentage of non-plastics, such as quartz sands and mudstone, and by a lot of organic fibres. Fabric 3 is characterized by small elements of lime and some mudstone; this might indicate a better levigation or deliberate choice of Damiyah clay. Loom weights made with this fine yellow, orange or grey clay are smooth, and because they are not brittle, most of them are undamaged. This fabric is the most common for the loom weights (it is used in 9 of the 14 groups). The clay of the loom weights was tempered with organic material, sand and small stones. Some loom weights show different and unusual tempers such as reused pottery sherds, shell fragments, basalt and flint (see also Chapter 4).

Gypsum

Gypsum loom weights have only been found in Strata II and III. Six loom weights are made of only gypsum; four loom weights are made of a mixture of gypsum and fine levigated clay. Both kinds are donut-shaped or spherical. Loom weights made of a mixture of gypsum and clay all come from Stratum II. The clay is yellowish, with iron oxide particles (fabric 3). The loom weights made of the mixture of clay and gypsum are about the same weight as the regular clay weights. The loom weights made only of gypsum are larger but relatively light in weight.

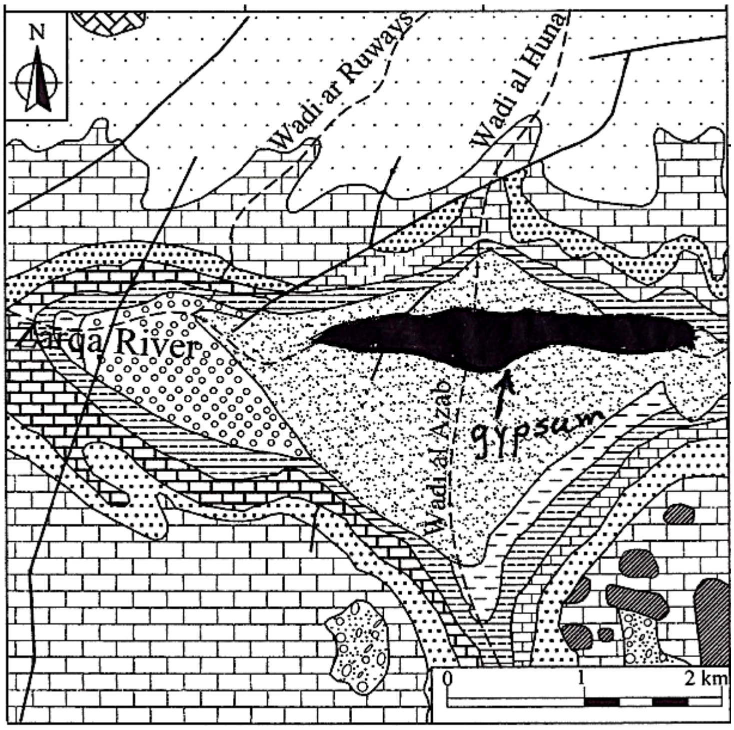


Fig. 7.6. Gypsum layer in Zerqa Basin (after Makhlouf and El-Hadad 2006:373).

[90] Clay from the Damiyah/Lisan formation (Groot 2007) is the same clay that Kalsbeek (1969), Franken (1992:105-114) and Van der Kooij (1989) called 'banded Lisan clay'.

Gypsum loom weights have been found in Iron Age IIA contexts at different sites in the Beth Shean Valley: at Tel el-Hammeh (Cahill, Tarler and Lipowitz 1989:36), Tel Rehov and Tel Amal (Mazar 2006:482) and Beth Shean (Mazar 2006:482-483 with comments by Shamir). They are all conical in shape and horizontally perforated. The loom weights from Tell Mazar are later in date (Iron Age IIB and C) and probably made of one of the local gypsum deposits. The thickest layer of gypsum (60 m) is in the river Zerqa Basin between Wadi Abu Ruweis, the Arda River and Wadi al-Azab, not far from Tell Mazar (Muneizel and Khalil 1993; Makhlouf and El-Hadad 2006:373) (fig. 7.6)

Fig. 7.7. Two donut-shaped loom weights from a pit in MA1:8.
Left: a gypsum loom weight, right: a clay loom weight (made of fabric 3).

Fig. 7.8. Left, two gypsum loom weights from a pit (in Area M square A1:5), found together with a clay anchor-shaped loom weight in the same locus.

Limestone

Two limestone loom weights have been found, no. 334 is a donut-shaped weight found in Area L in square G4:16, weight 656 g; width 10.4 cm; height 4.9 cm; perforation diameter is 2 cm (fig. 7.10).

Fig. 7.9. Stone loom weight no. 334.

Number 333 is a limestone loom weight found together with a clay one. The limestone weight is donut-shaped, with a diameter of 12.1 cm, a height of 5.1 cm and a weight of 824 g; the perforation is 2.5 cm. (fig. 7.10).

Fig. 7.10. Stone loom weight no. 333 (r) and clay (l) loom weight from GE7:22.

Alabaster

One loom weight was made of alabaster (fig. 7.11); it was conical in shape, with a round base. Measurements: width 3-5.5 cm, height 8 cm, perforation diameter 0.8 cm, weight 220 g. Its provenance is uncertain, but it probably came from Stratum I (Van der Steen, pers. comm.). It is possible that this was not a loom weight at all, but some other sort of perforated weight or an ornament.

Fig. 7.11. Alabaster weight (No. 539) on display in the Museum of the University of Amman. Also published in Yassine 1988 Plate XVII.

Groups of loom weights indicating a loom

Fourteen large groups of weights representing a loom will be discussed. To determine a group of loom weights belonging to one loom, square and locus are taken as selection criteria. Using the criteria of the find-spot defined as square and locus made it possible to identify looms without a detailed analysis of the stratigraphy. This choice limited the numbers of loom weights in a group as well as the number of groups. A *large group* is a collection of loom weights containing ten or more weights from one square and locus number. The choice for a minimum of ten weights is based on the fact that this is the minimum number of weights that makes weaving on a warp-weighted loom possible. If fewer than ten weights were used, the cloth would be so narrow (less than 20 cm) that it would not be worth the work of warping the loom and having it occupy space in a room. Other weaving methods would be chosen for such a narrow piece of fabric (see also Chapter 4).

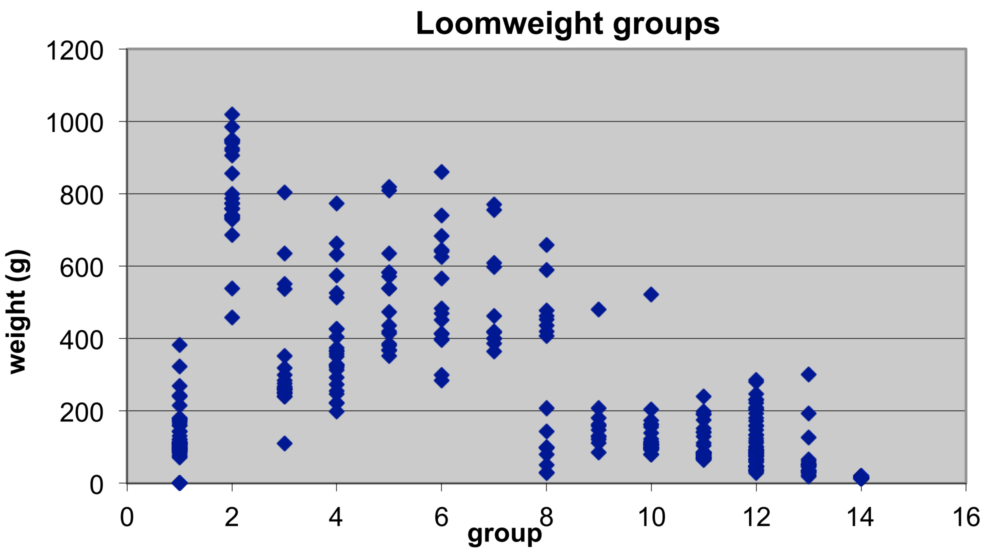


Fig. 7.12. Scattergram showing the weight of loom weights within the different groups.

Stratum V

Stratum V yielded only one group of loom weights found in two different loci. According to the labels on the stored loom weights the loci were regarded as being equal.

Group 1

Found in room 503 (Locus LE1:19) situated in the northwestern part of Area G (fig. 7.1.) This room contained several storage jars filled with wheat grain, and a large group of loom weights, assumed to belong to one loom. In the eastern part of the room a 'bathtub' was placed on a brick platform (Yassine 1988 Pls.VII:1; VIII:2; IX:1). Group 1 consisted of 56 loom weights, with weights ranging from 74 to 382 g; the average weight is 132 g, the average diameter 5.5 cm, and the average perforation diameter 1.4 cm.

Type	Number	Weight range in grams
Cylindrical	1	100
Donut-shaped	21	78 - 242
Spherical	33	74 - 382
Wheel-shaped small	1	90
Total	*56*	*Average weight 132*

Table 7.4. Group 1.

All the weights in Group 1 are made of fabric 1.

The weights in Group 1 are representative for the type of loom weights used in the Iron Age. Donut-shaped and spherical loom weights dominate. But the weight of this group is relatively low, only 132 g on average. Usually the weight of IA loom weights is between 100 and 300 g in the hill country, while in the Jordan Valley they vary between 250 – 670 g. The small wheel-shaped loom weight is the only known small wheel-shaped specimen found in the Southern Levant. In Stratum III and at Tell Deir Alla wheel-shaped loom weights are always over 250 g. This means that here the small wheel-shaped loom weight of 90 g was used as a small donut-shaped weight; the shape (especially the thickness which is important for spacing the warp threads evenly) is very much the same, pointing to the phenomenon described in the chapter on the typology (mixed forms Chapter 4).

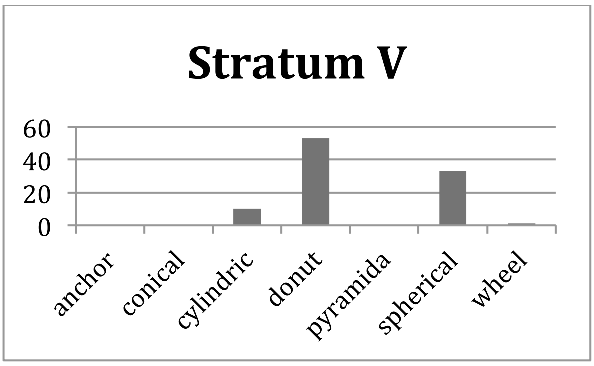


Fig. 7.13. Loom weights from stratum V.

Fig. 7.14. Room 503. The 'bathtub' (central) and some of the loom weights from group 1 (left upper corner). (Yassine 1988:100 pl. VII).

Fig. 7.15. The loom weights from group 1.

The loom weights were found in the southeastern corner of room 503 (fig. 7.1). In this room a 'bathtub' (fig. 7.16) was also found. It has been suggested (Mazow, pers. Comm.) that these 'bathtubs' were used for the fulling of wool. Another possible function would be for dying yarn or cloth. But the 'bathtub' could also have been used as a bin to store grain. On fig. 7.14 the loom weights seem to form three or more lines, indicating pattern weaving – see Chapter 3.

Fig. 7.16. The 'bathtub' now on display in the Museum of the University of Amman (courtesy of E. van der Steen).

Stratum III
Stratum III yielded seven groups of loom weights that could be ascribed to 7 different looms.

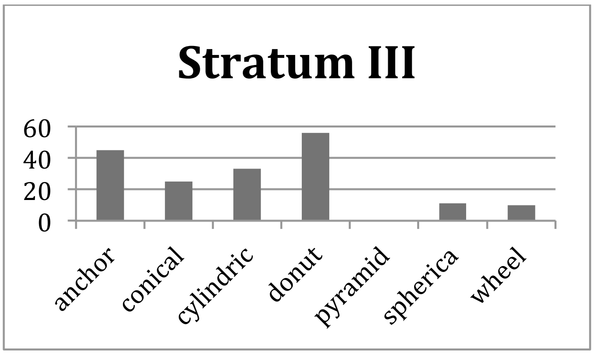


Fig. 7.17. Loom weights from Stratum III.

Group 2
Found in locus GE7:5 and 17 (fig. 7.2).
In the northwest corner of Room 318, between W101 and the north baulk, 26 loom weights were found embedded in hard yellow clay containing clay lumps with reed impressions, interpreted as roof rubble. This suggests that the loom stood on the roof of the building. The group consists of large and heavy loom weights. Some of the 15 loom weights of the mixed type (a combination of a cylindrical and a spherical shape) are shown in fig. 7.18. The total weight of all the loom weights in this group is 16,596 g, the average weight is 638 g and the average diameter is 7.4 cm, with an average perforation diameter of 1.3 cm. All the weights in this group were made of orange clay of fabric type 1.

Type	Number
Mixed type (cylindrical/spherical)	15
Donut-shaped	*9*
Spherical	*2*
Total	*26*

Table 7.5. Group 2.


Fig. 7.18. The loom weights of group 2.

Group 3
Found in GE8:14 group I (fig. 7.2).
This group consisted of 21 loom weights with a total weight of 6.708 g. Their average weight is 335 g, average diameter 6.8 cm, and the average perforation diameter is 1.8 cm. This is an interesting group because four of the loom weights (two anchor-shaped and two donut-shaped) are very heavy while the others are homogeneous in weight and shape. The heavy weights average 631 g and the smaller loom weights have an average weight of 230 g. All the weights were made of fabric 1. All of the loom weights were fired when the building was destroyed. The looms of Groups 3 and 4 may have stood on the roof of the same building as the loom of Group 2. Two groups of loom weights were found in a layer of burnt red mudbricks and roof rubble in the northeastern part of the square.

Type	Number
Anchor	3
Cylindrical	3
Donut-shaped	15 (2 large)
Total	*21*

Table 7.6. Group 3.

Fig. 7.19. Group 3.

Group 4
From GE8:14 group II (fig. 7.2).
This group consisted of 27 loom weights with a total weight of 10.098 g. Their average weight is 387 g, their average diameter 7.6 cm, and their average perforation diameter 1.8 cm. This group is very diverse in weight and in shape. There are six large loom weights with an average weight of 614 g. Five of these are large donut-shaped weights while one is an anchor-shaped weight. Most loom weights were made of fabric 3, but two donut-shaped weights were made of a mixture of gypsum and clay tempered with a great deal of organic material, resulting in a brittle and light loom weight. All of the loom weights were fired when the building was destroyed.

Type	Number
Anchor-shaped	1
Cylindrical	7
Donut-shaped	14 (5 large)
Spherical	1
Mixed type (sph/cylindrical)	4
Total	27

Table 7.7. Group 4.

Fig. 7.20. Group 4.

Group 5

Room 312 locus GH8:10 (fig. 7.2).

This group consisted of 19 loom weights, found in the northeastern corner of room 312 in square GH8 (fig. 7.2), with a lot of pottery found within mudbrick roof material on top of the floor. Apparently the loom stood on the roof of Room 312 very close to the neighbouring room 305 in square HA8; it was possibly even on the same roof (fig. 7.2). The total weight of the 19 loom weights is 12.983 g, their average weight is 683 g, while the average diameter is 5.9 cm and the average perforation diameter is 1.7 cm. The loom weights were made of fabric 3. Two domed anchor-shaped weights are extremely large and heavy: 2015 g and 2300 g respectively (figs. 7.21 and 7.37). Two more large anchor-shaped weights weighed 820 g and 808 g respectively (fig. 7.38). The remaining 15 weights in the group have an average weight of 469 g. Cone-shaped or domed and anchor-shaped loom weights weighing over 2000 g have been recorded at Tell Mazar and Beth Shean (Mazar 2006:478, fig. 13.16). Conical and donut-shaped ones have been found in Deir Alla phase IX (Chapter 6; Boertien 2004:322, fig. 11). In Deir Alla and Mazar and at Beth Shean, these heavy weights were found together with lighter ones in the same set of loom weights (see also conclusions at the end of this chapter).

Type	Number
Anchor-shaped	6
Anchor/dome	2
Anchor/cone	1
Conical	5
Cylindrical	3
Donut-shaped	2
Total	*19*

Table 7.8. Group 5 (locus GH8:10).


Fig. 7.21. Group 5. (See also figs. 7.38 and 7.39).

Group 6

Found in room 312 in locus HA8:22 (fig. 7.2).

A group of 22 loom weights was found together with a lot of pottery, a horse figurine, part of a bronze bracelet and an iron ring in the roof collapse that covered the floor of Room 312, so it is possible that the loom stood on the roof of the building. The total weight of the 22 loom weights is 10.952 g. Their average weight is 498 g, the average diameter is 6.3 cm and the average perforation diameter is 1.7 cm.

This is a remarkable group of heavy loom weights of different types. The weights were made of fabric 3 and most were carefully smoothed. The loom weights were fired when the building was destroyed.

Type	Number
Anchor-shaped	6
Conical	1
Conical	4
Con/ anchor like	2
Donut-shaped	3
Mixed type don/cyl	1
Mixed type don/sph	1
Mixed type wheel/cyl	1
Wheel-shaped	3
Total	*22*

Table 7.8. Group 6 (locus HA8:22).

Fig. 7.22. Group 6.

Group 7

Found in locus GH8:11 (fig. 7.2)

The 13 loom weights of this group were found in the corridor in front of Rooms 305 and 306, together with a lot of pottery and a pot stand. The total weight of the 13 loom weights is 5580g. Their average weight is 507 g, the average diameter 7.2 cm, and the average perforation diameter is 1.7 cm. There are four heavy loom weights within this group: two conical ones with a round base weighing respectively 598 and 608 g, a wheel-shaped weight of 770 g and an anchor-shaped weight of 756 g. The nine other weights have an average weight of 316 g. All loom weights were made of fabric 3. All of the loom weights from this group were fired when the building was destroyed. The loom stood in the corridor in front of Rooms 305 and 306, while on the roof of the building directly to the east of the corridor, the 'neighbours' had two looms standing on the roof (groups 5 and 6, fig. 7.3).

Type	**Number**
Anchor	1
Donut-shaped	*4*
Conical	2
Spherical	5
Wheel	1
Total	*13*

Table 7.9. Group 7 (locus GH8:11).

Fig. 7.23. Group 7.

Group 8

Found in storage room 313 in locus HA7:4 (fig. 7.2)

In storage room 313, eight loom weights were found together forming a kind of circle (fig. 7.39), perhaps the basket in which they were stored burnt away and left the loom weights in this arrangement. These loom weights (fig. 7.24 upper row and left) are relatively large, anchor-shaped weights made of grey clay with some mudstone, tempered with small to medium-sized organic material and stones, fabric 1. The surface of these weights shows a brownish scum. The total weight is 3906 g (two weights are damaged), their average weight is 488 g; the average perforation diameter is 1.4 cm, and the average height of this set is 10 cm.

From the same location, storage room 313, ten smaller loom weights with tiny perforations have been registered. These loom weights are small and made of fabric 3. They do not show the brownish scum of the heavier, anchor-shaped weights. In most of the weights the perforation is made from both sides, but in some instances the hole is perforated from one side and a bit of clay, still visible, is pressed out of the perforation. The weights were fired when the building was destroyed. The total weight of the ten weights is 837 g (one weight was damaged). Their average weight is 93 g, their average height is 4 cm, and the average perforation diameter is 0.5 cm. These weights are different in size, weights and perforation and made of different kinds of clay.

Type	**Number**
Anchor-shaped small	1
Anchor shaped large	8
Conical small	2
Donut-shaped	*1*
Pyramidal/square	*2*
Spherical small	*4*
Total	*18*

Table 7.10. Group 8 (Locus HA7:4).

An anchor-shaped loom weight made of fabric 3 was found in the nearby locus HA7:7. On one of the sides small circles were impressed in the wet clay (fig. 7.24 no. 247 and fig. 7.25). The measurements are: height: 8.7 cm, width: 5.2 cm, perforation diameter 0.8 cm, weight 276 g.

Fig. 7.24. Group 8 (from HA7:4) in the middle patterned loom weight no. 247 from HA7:7.

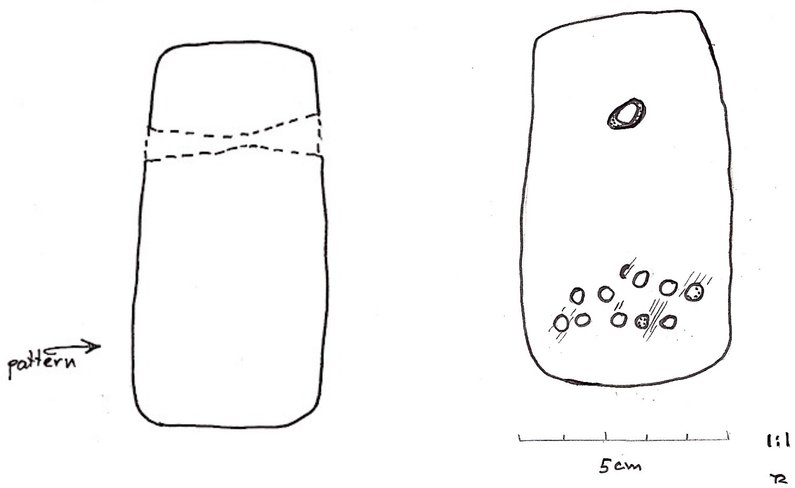


Fig. 7.25. Patterned loom weight 247.

Conclusions Stratum III

Stratum III yielded 136 loom weights of which the donut-shaped loom weight is dominant (31.1%), followed by the heavy anchor-shaped weight (25%) and the cylindrical loom weight (18.3%). There were no pyramidal and no small donut-shaped loom weights. (0.7%).[91] In general the loom weights from Stratum III are heavier than those of the previous and succeeding strata. Stratum III revealed some large groups of loom weights, which can be ascribed to seven different looms. Using the stratigraphic information, the different looms can be situated within the plan (fig. 7.2). Loom 7 stood inside the building, in the corridor opposite room 305 and 306 (GH8). The ten loom weights in room 313b (loom 8) may have been stored there together with the pottery, or belonged to a small loom that was stored in this room. The other five looms stood on the roof of the building: looms 6 and 5 on the roof of storage room 312, and looms 2, 3 and 4 on the roof of room 318.

[91] Ten loom weights are very small; it is not completely clear whether they are indeed from this stratum.

Stratum II
Four large groups of loom weights have been excavated in this stratum.

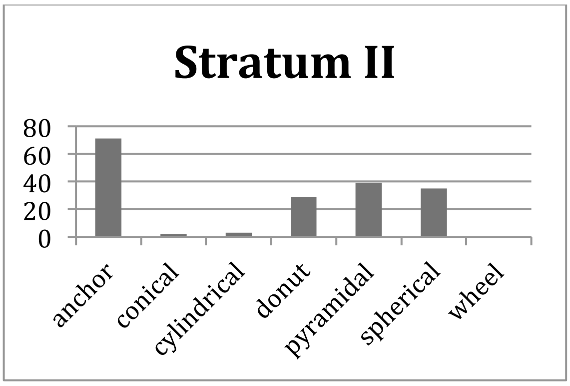


Fig. 7.26. Loom weights of stratum II.

Group 9
Found in locus GG7:8 (fig. 7. 3).
In GG7:8, eleven loom weights were found together with a horse figurine fragment, a bronze arrowhead and an iron knife. The loom weights were found on a floor between the foundations of W100 and W103 in room 207 (Yassine 1988:84, fig. 5). The total weight of this group is 1916 g, their average weight is 174 g, the average diameter of these weights is 5.0 cm and the average perforation diameter is 1.5 cm. One donut-shaped weight is made of gypsum (128 g, diameter 7 cm, perforation diameter 1.6 cm).

Type	**Number**
Anchor-shaped	1
Donut-shaped	*6*
Spherical	*4*
Total	*11*

Table 7.11. Group 9 (locus GG7:8).

Group 10
Found in locus LE1:10 (outside the plan of fig. 7.3 located in Area L).
The loom was in the northeastern part of the stratum. The loom weights were found in a deposit of mudbrick, with hard brown soil and some charcoal, possibly two surface layers. The group consisted of 28 loom weights with a total weight of 3645 g their average weight is 130 g, ranging from 80 to 522 g, with an average diameter of 5.2 cm and a average perforation diameter of 1.4 cm. Group 10 is a small group of loom weights made of fabric 3. All the weights were fired. The largest and most heavy weight in this set is an anchor-shaped patterned weight, weighing 522 g (see figs. 7.27, 7.28 and 7.29).

Type	**Number**
Anchor-shaped (with pattern)	1
Cylindrical small	*3*
Donut-shaped	*11*
Spherical	*13*
Total	*28*

Table 7.12. Group 10 (locus LE1:10).

Fig. 7.27. Group 10 from locus LE1:10, with the large patterned anchor-shaped loom weight 415 in the middle.

Fig. 7.28. Anchor-shaped patterned loom from group 10 (weight 415 from LE1:10).

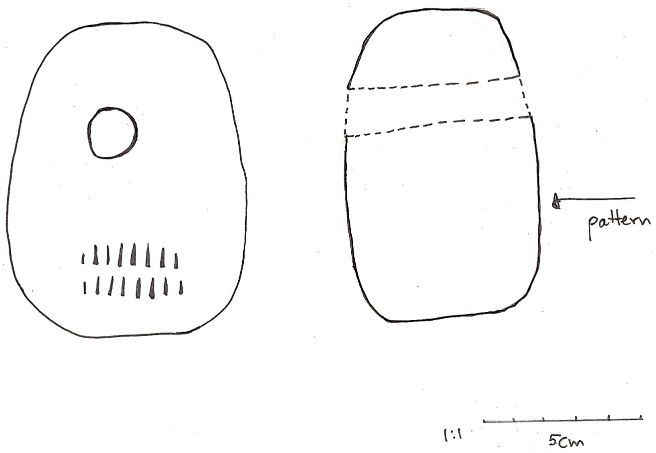


Fig. 7.29. Patterned loom weight 415.

Groups 11 and 12
Two groups of loom weights were found in locus HB8:6 (fig. 7.3).
The loom weights were found in a brick-lined pit belonging to room 212/213, together with a spatula, the handle of a dagger, and iron dagger and a bronze stick. The loom weights have been described as two different groups: one set (HB8:6-I) consisting of 39 loom weights and the other HB8:6-II consisting of 55 loom weights. Typological differences between the two groups support the idea that they represent two different looms; therefore they are described as groups 11 and 12.

Group 11.
Found in locus HB8:6 [labelled as HB8:6 -I] (fig. 7.3)
This group consists of 39 loom weights with a total weight of 3477 g and an average weight of 89 g. The average diameter is 3 cm. The weights were made of fabric 3. They were smoothed, not fired, the perforation was made from two sides and the perforation diameter was small: 0.6 cm.

Type	Number
Anchor-shaped	16
Pyramidal	7
Square	15
Spherical (small)	1
Total	*39*

Table 7.13. Group 11.

Group 12.
Found in locus HB8:6 [labelled as HB8:6- II] (fig. 7.3)
This group consists of 55 loom weights with a total weight of 6035 g and an average weight of 110 g. The average diameter is 3.7 cm. The weights were slightly larger than the weights of group 11. The loom weights of group 12 were made of fabric 3. The weights were smoothed and not fired. The perforation was made from two sides, and the average perforation diameter is 0.6 cm. Within group 12 the weights are on average 20 g or 20% heavier than the weights in group 11, suggesting that different kinds of yarn were used in the warp of each loom. The clay and temper are the same in both groups, as is the perforation diameter. The loom weights of group 12 are more diverse in shape, suggesting that some other kind of cloth (with a different structure) was woven because the thickness of the weights is more diverse, which causes a difference in the space between the warp threads, resulting in a more open weft (Anderson Strand 2010:18).

Type	Number
Anchor-shaped	28
Donut-shaped	1
Donut-shaped small	8
Mixed type (donut/wheel)	1
Pyramidal	9
Spherical	8
Total	*55*

Table 7.14. Group 12 (locus HB8:6).

Conclusions Stratum II
Most of the loom weights from Stratum II were found in unclear stratigraphic situations or in pits. An exception is group 9, which was on the floor of room 207. The dominant type in this stratum is the anchor-shaped loom weight. Spherical and pyramidal weights are represented but the donut-shaped weight has become rare. Most significant is the reduction in average weight compared to the earlier strata. The average weight of all the registered loom weights from Stratum II is 119 g, while the average weight of the loom weights of the groups (reconstructed looms) is 125.7, ranging between 89 and 174 g.

Locus group	Average weight/ grams	Average diameter of perforation/cm
GG7:8. Group 9.	174	1.5
LE1:10. Group 10.	130	1.4
HB8:6 (group I). Group 11	89	0.6
HB8:6 (group II). Group 12	110	0.6

Table 7.15. Loom weights Tell Mazar Persian Period (Stratum II) n=133.

The loom weights of Stratum II can be compared to the three Persian Period loom weights of Tell Ta'anach: the pyramidal loom weights weighing 66, 83 and 86 g respectively (Friend 1998:10, 59-60 and 73). Light donut-shaped loom weights (20-50 g) are known from various sites in Cisjordan, such as Khirbet Nimra (Shamir 1997). The donut-shaped weights of Tell Mazar are heavier than those of Khirbet Nimra.

Stratum I

This stratum consisted of numerous pits, silos and granaries; on the basis of the contents, a large group of pits could be dated to the Early Hellenistic Period. Some of these pits were over 2 m in diameter and over 4 m deep. The deposits in the silos and granaries do not necessarily represent the original use. In many cases they have been reused for storage or waste judging from their contents, which ranged from charred grain and charcoal, to pottery, copper, stone vessels and loom weights.

The plan of this period (fig. 7.30) does not show any built features but only pits, silos and granaries. Such installations have also been found at contemporaneous levels at Tell Deir Alla and Tell es-Saidiyeh (Yassine and Van der Steen 2012:14). Because there is a significant difference in the type of loom weights between the Iron Age and the Early Hellenistic Period it was possible to ascribe two groups of loom weights to the Early Hellenistic Period.

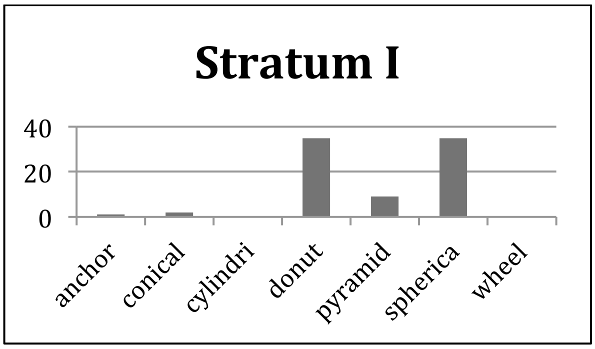


Fig. 7.31. The loom weights of Stratum I.

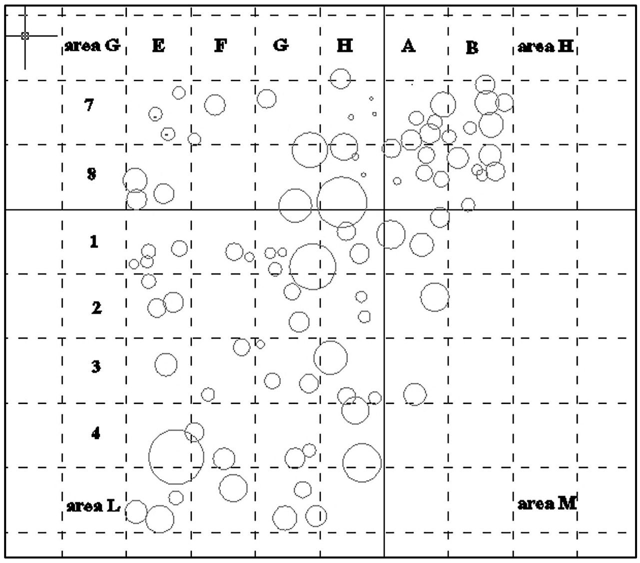


Fig. 7.30. Plan of The Early Hellenistic Period (Courtecsy of E.van der Steen).

Group 13
Found in a pit in locus HB7:13.
The first group consists of 21 loom weights. They were made of selected and well-mixed clay, one of them with mudstone particles visible in the clay fabric. The weights were unfired, well formed and smoothed. The temper consisted of small organic matter with small to medium-sized stones, resembling fabric 3. The diameter of the perforation was very small and the perforation was generally made from both sides, in one of the loom weights two complete perforations have been made. A few of the weights were perforated from one side. The weights were fired during the destruction of the building. The heavier weights range from 126-302 g, the very light spherical weight is 18 g; the weight of the other 17 specimens ranges between 24 and 66 g. The total weight of the group is 1254 g, the average weight is 66 g, and the average diameter is 4.2 cm. The average perforation diameter is 0.5 cm. No picture is available of this group; the loom weights are similar to those in fig. 7.32. Two groups in Locus HD1:5 revealed a mixed lot of 39 loom weights from different periods.

Type	Number	Weight/grams
Anchor small	1	--
Conical small	1	66
Donut-shaped	*2*	*126 - 302*
Donut small	*2*	*-- - 60*
Mixed type	*9*	*24 - 54*
Pyramidal	*1*	*194*
Spherical	*5*	*36- 60 and 18*
Total	*21*	*1254*

Table 7.16. Group 13 (locus HB7:13).

Group 14
Found in locus HD1:5
Group 14 consisted of 33 loom weights of typical Hellenistic type and weight representing a loom. They were found south of wall W100 in a brick rubble deposit, which also contained mixed pottery ranging from Iron Age II to the Hellenistic period. The weight of all the loom weights together is 414 g their average weight is only 15 g (ranging from 12-20 g), while the diameter is 2.5 cm. The perforation diameter is 0.4 cm. No picture is available of this group; they are similar to those in fig. 7.32.

Type	Number	Weight/grams
Mixed type (don/sph/cyl) small	17	12 to 20
Spherical	16	12 to 18
Total	*33*	*414*

Table 7.17. Group 14 (locus HD1:5).

Conclusions Stratum I

According to Shamir, the loom weights of the Hellenistic period in general tend to be numerous, small and light (Shamir1996:148; 2004:26) and this is what we can see at Tell Mazar. The weights from Stratum I were unfired, small (average weight 40 g) with tiny perforations and very carefully made. They represented various types: the small donut-shaped, the spherical and the small square base pyramidal loom weights dominate.

Fig. 7.32. Early Hellenistic loom weights from Stratum I (found in locus HD2:1) demonstrating the different types used in this period. The group could not be discussed because the locus was situated in the topsoil.

It is interesting that so many different types were used within these sets of almost 'miniature' loom weights (fig. 7.32 shows a group of small Hellenistic loom weights found in the topsoil). Pyramidal loom weights are known from the Hellenistic and Early Roman periods from Tel Anafa, Ashdod Stratum 3a, Tel Maresha, Masada, Tel Michal, Samaria (Shamir 1996:148;2004:26). In Jordan pyramidal loom weights have only been reported from Pella (McNicoll 1982:74, pl.156). The small donut-shaped, spherical and anchor-shaped loom weights are comparable to those described for the Persian period at the Negev sites of Horvat Rogem, Horvat Mesura and Horvat Ha-Roa (Shamir 2004) and the donut-shaped Persian Period loom weights (20-50 gram) from Khirbet Nimra (Shamir 1997). The light loom weights were used to produce fine textiles with very fine threads. Shamir (1997; 2004:26) has reconstructed a warp-weighted loom using light loom weights (20-40 g) from Maresha. It was found that the weaving could be accomplished with a maximum of three warp threads tied to each loom weight; the weaving proved more successful when heavier loom weights were tied at the edges (Sheffer1981; Shamir 1994).

7. 4 Discussion and results

Manufacturing marks on loom weights

Some of the loom weights found at Tell Mazar show manufacturing marks such as the fingerprints of the person who made the loom weight (fig. 7.33). See also Chapter 4.2 (figs. 4.11 and 4.12).

Fig. 7.33. Manufacturing marks: no. 363 fingerprints, no. 359 waster, no. 354 clay pressed out of the perforation.

Patterned loom weights

Several loom weights show small marks on the surface of the weights; the marks were made on the weights while the loom weights were still wet (figs. 7.25, 7.28, 7.29 and 7.34). The function of these motifs is unknown. Because the motifs are invisible while weaving it is unlikely that the patterned loom weights had a special function during weaving; the marks may have had a function while warping the loom. Because only a very few loom weights were 'marked', the signs possibly functioned as owners' marks. Because only a few loom weights have these marks, they possibly mark groups of loom weights stored in some communal place in order to distinguish a whole set of loom weights.

Fig. 7.34. Patterned loom weight no. 60 from GE:2.

Signs of wear

On twelve loom weights from Tell Mazar grooves can be identified inside the perforation holes, created by the rubbing of a single thread (fig. 7.35). This shows that the warp threads were adjusted to the loom weights with an intermediary loop of a single thread (see Chapter 3). Wear of this kind is often found in loom weights.[92] (See also fig 6.25 and Chapter 4.2, fig. 4.13).

Fig .7.35. Signs of wear visible in anchor-shaped loom weight No. 28 from group GH8:10/6 found in a small group of nine loom weights in Stratum III.

Weight variation in loom weights over the ages

Out of the 543 loom weights from Tell Mazar that have been studied, 390 (71.8%) seem to have come from a more or less complete loom. This offered a unique opportunity to study the typological development of loom weights from Iron Age IIB through the Persian Period into the Early Hellenistic Period. The loom weights of Mazar confirm the idea that Levantine loom weights increased in weight during the Iron Age and declined in weight again in the Persian and Hellenistic periods (Shamir 1996:146, 151; Friend 1998:9-10).

The Iron Age loom weights from Tell Mazar

In the Iron Age levels the typology is dominated by donut-shaped, conical, wheel-shaped and cylindrical loom weights (fig. 7.34). When compared to Deir Alla phase IX, the Iron Age IIb/IIc (Stratum V) loom weights are relatively light weighing 132 g on average. In Iron Age IIc (Stratum III) the weights are rather heavy, weighing over 500 g on average.

In the Persian period (Stratum II) heavy anchor-shaped weights (427 g) were used together with medium-sized anchor-shaped loom weights with a more or less rectangular base. Medium-sized donut-shaped and spherical loom weights were used, and a new type was introduced: the lighter, pyramidal loom weights (147 g). Combining these different weights results in a lighter average weight with small perforations.

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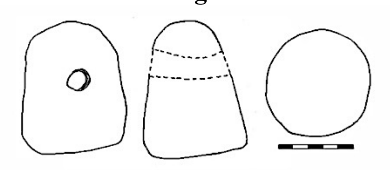
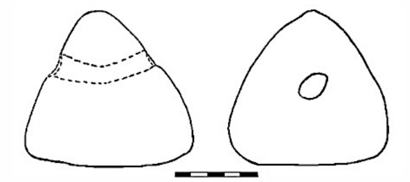
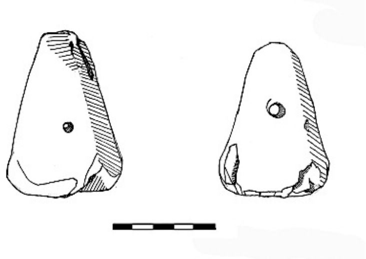
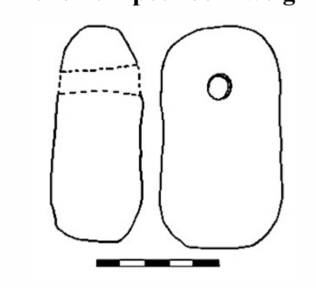
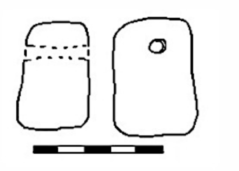
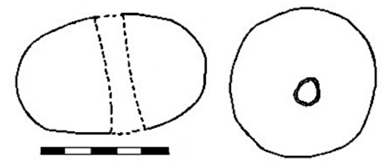
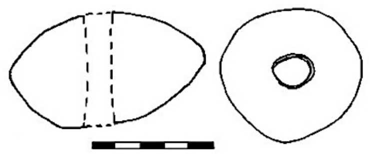
[92] This phenomenon has been found at other Iron Age sites such as Deir Alla (this volume Chapter 6.6 figs. 6.24-6.26; Boertien 2004:323, 329, figs. 25, 26); Tell Khirbet al-Mudayna (this volume Chapter 8.3 and figs. 8.29 and 8.30); Kadesh Barnea (Shamir 2007:265), Tell Batash (Browning 1988:195-200); Tell Taanach (Friend 1998:36, 39, 41, 42, 44, 46, 50, 53-58 and 60) and Vered Jericho (Shamir 2007:265).

Stratum	Period	Average diameter of perforation/cm	Average weight/ grams	Total n=390
VI	Iron Age IIb 8th century BC	1.5	287	n= 5
V	Iron Age IIb/IIc 8th-7th century BC	1.4	132	n=56
IV	Iron Age IIc 7th century BC	--	--	n= 0
III	Iron Age IIc 7th - 6th century BC	1.6	505	n=136
II	Persian Period 5th century BC	1.0	126	n=133
I	Early Hellenistic Period 4th century BC	0.6	73	n=60

Table 7.18. Loom weights through the different strata.

Horizontal perforation (pendant)	
Conical loom weight 	*Conical loom weight* Characteristics: Conical body with a circular or elliptical base. Diameter of the perforation varies from 0.5 to over 2 cm. Stratum III
Pyramidal loom weight (circular base) 	*Pyramidal loom weight* Characteristics: Pyramid-shaped body with a circular base; measurements differ. Diameter of the perforation varies, usually over 1 cm. Stratum II
Pyramidal loom weight (square base) 	*Pyramidal loom weight (square base)* Characteristics: pyramidal square body with a square base; measurements differ. Diameter of the perforation diameter varies, usually under 1 cm. Stratum II
Anchor-shaped loom weight 	*Anchor-shaped loom weight* Characteristics: height exceeds diameter, body and base elliptical or more or less flattened rectangular with rounded top and flat ends. Perforation diameter varies, usually over 1 cm. Stratum III and II
Square loom weight (small) 	*Square loom weight* Characteristics: Small loom weight with a flattened top and a square base. Perforation diameter under 1 cm. Stratum III and II

Typology of perforated clay loom weights from Iron Age strata at Tell Mazar.

<table>
<tr><th colspan="2">Central perforation</th></tr>
<tr><td>Donut-shaped loom weight

a

b</td><td>Donut-shaped loom weight
Characteristics: the weight was made from a coiled piece of clay < 9 cm, the coil was wound around the finger to create the shape.

a. Regular donut-shaped loom weight. Characteristics: less than 9 cm in diameter. Width 1 cm wider than height. Perforation diameter 1-2 cm.

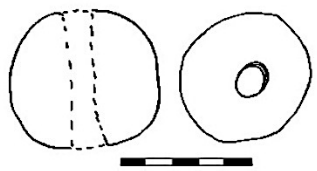
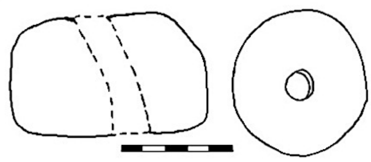
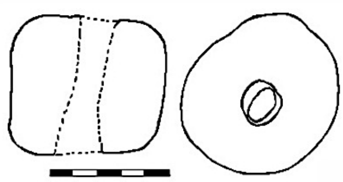
b. Biconical weight. A donut-shaped loom weight. The elliptical shape is non-discriminating, it was made in the same way as the donut-shaped weight, resulting in identical characteristics: less than 9 cm in diameter. Width 1 cm more than height. Perforation diameter 1-2 cm.
Strata V, III and II</td></tr>
<tr><td>Spherical loom weight
</td><td>Spherical loom weight
Characteristics: Width and height vary no more than 1 cm.
Ball-shaped loom weights are over 5 cm in diameter. Perforation diameter over 1 cm.
Strata V, III, II</td></tr>
<tr><td>Wheel-shaped loom weight
</td><td>Wheel-shaped loom weight
Characteristics: Width more than 1 cm wider than height, more or less flat ends. Usually over 9 cm in diameter. Perforation diameter over 1 cm.
Strata V and III</td></tr>
<tr><td>Cylindrical loom weight
</td><td>Cylindrical loom weight
Characteristics: Width and height vary no more than 1 cm, flat ends. Perforation diameter over 1 cm.
Strata V, III and II</td></tr>
</table>

Fig. 7.36. Typology of Iron Age loom weights from Tell Mazar.

Loom weights from the Early Hellenistic Period

In the Early Hellenistic period loom weights are different from those in the Iron Ages. Loom weights became progressively smaller and lighter, to an average weight of only 73 g in the Early Hellenistic period (fig. 7.37). Small spherical and donut-shaped loom weights predominate; they are combined with small square loom weights and small pyramidal loom weights with a square base (fig. 7.32).

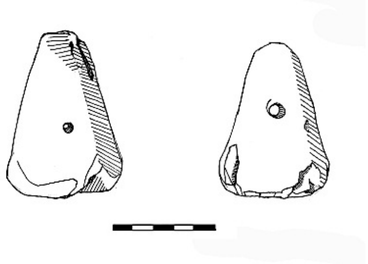
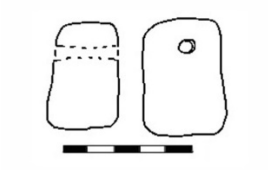
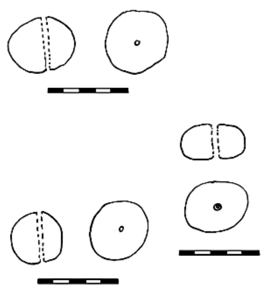
Pyramidal loom weight (square base) 	*Pyramidal loom weight (square base)* Characteristics: pyramidal square body with a square base; measurements differ. Diameter of the perforation is usually under 1 cm.
Square loom weight (small) 	*Square loom weight* Characteristics: Small loom weight with a flattened top and a square base. Perforation diameter under 1 cm.
	*Small spherical loom weight (left)* Characteristics: Ball-shaped, small spherical loom weights are under 4 cm; perforation diameter under 1 cm. The weights are perforated using a (thin) stick or a rod. *Small donut-shaped loom weight (right)* Characteristics: Width is more than 1 cm wider than the height. Small donut-shaped loom weights are under 4 cm in diameter, with a perforation diameter of under 1 cm. The weights were perforated using a (thin) stick or a rod.

Fig. 7.37. Typology of Early Hellenistic loom weights from Tell Mazar (4th century BC).

Weight variation in Iron Age loom weights

At Tell Mazar a wide variation in weight of the Iron Age loom weights was found (74-2300 g). At several more Iron Age sites very heavy weights (> 1 kg) do appear within sets of lighter loom weights, but only a few extremely heavy weights have been found, forming a very small percentage of the total number of loom weights. This phenomenon was found at Gordion (Burke 2010:117, fig. 61,62) and Beth Shean (Mazar 2006:478 photo 13.16). Comparable weights have also been found at Tell Deir Alla (Chapter 6; Boertien 2004:322, 314, fig 11; Franken 2008:44, Fig. 3).[93] Shamir states that these heavy loom weights could not have been used on the warp-weighted loom because their weight would have broken the yarn; her experiment showed that a weight variation of more than 200 g would cause a disorder in the warp (Shamir 1996:144). She wrote that although loom weights of very different weights were found together, this does not mean that they were used together. However, Barber stated: ‘Such differences within a set seem bizarre and unnatural to us in our modern machine-regulated world. But research shows that great variation is not fatal to weaving on the warp-weighted loom, although it does not make life easier.’ (1991:95). In her research on warp-weighted looms in modern Scandinavia, Hoffmann found that

[93] The huge weights from Tell Deir Alla are spherical (1050 g), conical (2749 g), and donut-shaped (2400 g).

women tied proportionally more warp threads to the heavier loom weights. In one case the weights being hung on one and the same loom varied from 1500 to 4500 g (1964:42). Experiments at the Danish Centre for Textile Research (TTT Copenhagen) confirmed that relatively heavy weights could indeed be used together with lighter ones (Andersson Strand, pers. comm.).

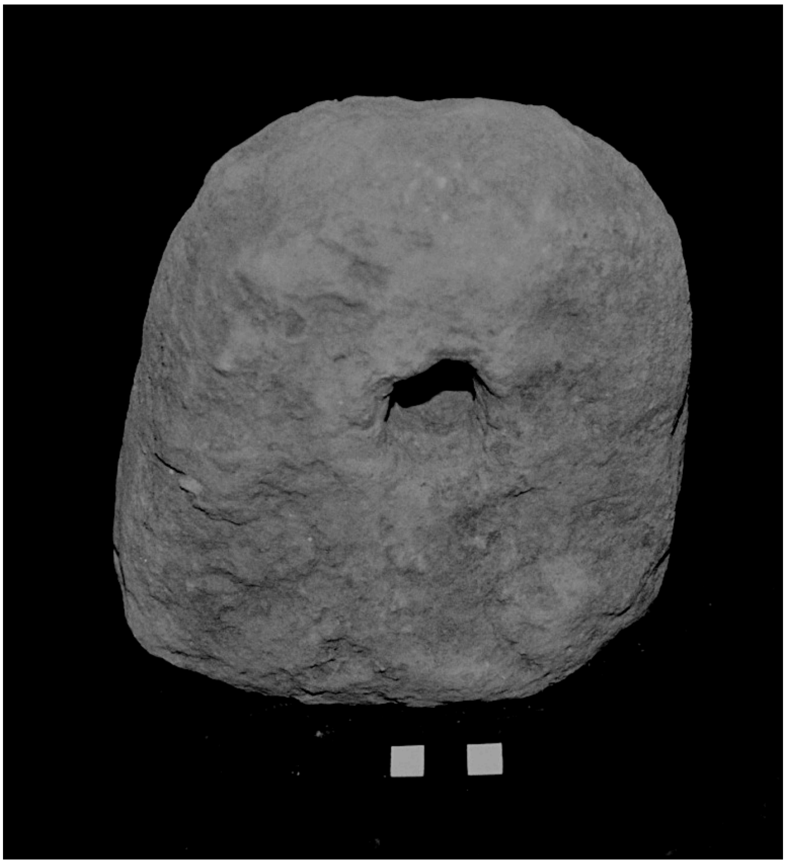


Fig. 7.38. Extremely large and heavy loom weight from group 5 (GH8/10), weighing 2300 g (the heavy weight within the group, see fig. 7.21).

Fig. 7.39. Large loom weights from group 5 (GH8/10), weighing 808 and 820 g (the heavy loom weights within the group, see fig. 7.21).

Textile production
Architectural constructions used in textile production are rarely found, or can rarely be recognized as such because we do not know enough about the production processes used in the past. However, the 'bathtubs' found at Tell Mazar may have been used in textile production.
Group 1 was found next to a 'bathtub' (fig. 7.16) placed on a brick platform. This construction is similar to five mudbrick installations excavated at Tell Deir Alla, two of which were found in connection with loom weights (Van der Kooij and Ibrahim 1989:82,89, fig. 102, 104, 108; pers. obs.) The mudbrick installations cannot be associated with the warp-weighted looms, but the tubs may have been used for the fulling of wool (Mazow 2010 and pers. comm.).[94] Another possible function may have been for dying yarn or cloth.

Where did they weave?
Stratum III (fig. 7.2) yielded several large groups of loom weights, representing more or less complete looms, which can be situated on the plan. Weaving, especially when intricate patterns are involved, requires a lot of light. The warp-weighted loom is a mobile construction; it could be carried to the place where the weaver wanted to work, perhaps in a doorway, the courtyard or on the roof. Group 7 (a small loom) stood in the corridor opposite rooms 305 and 306. Logic dictates that this is not the place where the weaving activity took place because it is a very dark part of the building. But such small looms can easily be picked up and carried to a place with enough light to weave.[95] Groups 5 and 6 stood on the roof of storage room 312. And groups 2, 3 and 4 stood on the roof of room 318 (fig. 7.2). More examples of looms on roofs can be found in Jerusalem (Steiner 2001:100), Timnah (Browning 1988:133), Deir Alla (Chapter 6; Boertien 2004:324); the phenomenon has also been described at Kato Zakro on Crete (Platon 1971:57, 191, 281).
When not in use, loom weights were kept in storage.[96] The loom weights of Group 8 were found in storage in room 313b. At Mazar six loom weights were found grouped as if they had been stored in a basket group 8 (fig. 7.40). The basket had burned away and the loom weights were still grouped in the shape of the original basket. (See also Deir Alla group III, Chapter 6.4 and fig 6.16).

What did they make?
The Iron Age loom weights used in the Jordan Valley are about 150-200 g heavier than those used in Moab in Khirbet al-Mudayna (Chapter 8) and Mudaybi (Wade and Mattingly 2002) and at Tell er-Rumeith in the northern hill country of Gilead (Chapter 9).
The rather high average weight (over 450 g) of the loom weight in the Jordan Valley points to the use of strong vegetal yarn such as linen and hemp (Boertien 2004; 2007); woollen yarn is much weaker and needs less tension and therefore lighter loom weights can be used to weave wool. Climatic and soil conditions of the Jordan Valley are suitable for growing hemp and flax. Flax seeds have been excavated from different sites in the Jordan Valley (Van der Kooij and Ibrahim 1989:34; Petit 2009:24). At Tell el-Hammah (Cahill *et al.* 1989:36) a spindle with linen threads still wrapped around it has been found. In combination with the hemp textile found at Tell Deir Alla (Vogelsang-Eastwood 1989:61; Boertien 2004:306-308; 2007:68; this volume Chapter 6), it seems reasonable to suggest the production of vegetable yarn at Tell Mazar.

[94] Fulling involves two processes, scouring and thickening. Scouring was conducted by standing ankle deep in tubs of human urine and stamping and pounding the cloth. Stale urine, known as wash, was a source of ammonium salts and assisted in cleansing and whitening the cloth. The second function of fulling was to thicken cloth by matting the fibres together to give it strength and increase waterproofing (felting). After this stage, water was used to rinse out the foul-smelling liquid used during cleansing.
[95] These looms would weigh about 7 to 8 kg. The combined loom weights weigh about 5.5 kilos, to which the weight of the wooden loom and that of the wool or linen that was being woven has to be added.
[96] In the excavated material of Tell Deir Alla phase IX, a small group of weights (group III) was found lying together in the storage room; obviously they had been stored in a basket, but the basket burnt away in the conflagration of phase IX and the loom weights were left forming a small circle (Boertien 2004:319).


Fig. 7.40. Loom weights in storage showing how they were left after the basket in which they were stored burned away. Group 8. (Yassine and Van der Steen 2012:13 fig. 27; Yassine 1988 Plate III:1).

Patterned cloth

A loom can be operated in a number of ways, depending on the weaving technique used. Two rows of loom weights were used for a tabby weave (fig. 2.7). When patterns are being woven, such as different kinds of twills, more layers of warp threads are needed. There are many variations of twill; for example a 2/2 twill (fig. 2.11) requires four layers of warp threads, resulting in four rows of loom weights. To create a 2/1 twill, three layers of warp threads are used, resulting in three rows of loom weights (Andersson Strand 2010:15-16, fig. 2.10).

The loom weights of group 1 as found show their position on the warp-weighted loom. They were found in three or four rows on the spot where the loom must have stood. This shows clearly that patterned cloth was woven on this particular loom, which is also suggested by the relatively high number of 56 weights. The number of loom weights used in group 12 (55 loom weights) suggests that this loom was also operated with 3 or more rows of loom weights, and that a patterned weft was produced.

7.5 Conclusions

The different types of loom weights throughout the periods at Tell Mazar partly accord with the typology of loom weights from other sites in the Levant. In the Early Hellenistic period the typology of the loom weights from Tell Mazar correlates to a large degree with the typology as known from Cisjordan (Friend 1998:71-75), where in the Persian period the characteristic pyramidal loom weight came into use, alongside the anchor-shaped, donut-shaped and spherical loom weights. But in the Iron Age, the Ammonite loom weights differ from those of other parts of Transjordan and Cisjordan. All over the Southern Levant the donut-shaped loom weight dominated, while in Ammon the donut-shaped weight was always combined with other types of loom weights, such as spherical and cylindrical ones. This pattern occurs not only at Tell Mazar, but can also be seen at the sites of Tell Deir Alla and Tell Jawa (see also Chapters 6 and 10; Daviau 2002:191-198).

The excavated loom weights reveal that at Tell Mazar not only simple tabby weaves were produced but also patterned textiles, such as different kinds of twills. Heavy loom weights were used to produce a heavy thick textile and lighter loom weights to make a thin light textile (Andersson Strand 2010). When using bast fibre, heavier weights are required to stretch the warp threads than when using wool (Burke 2010:114-115). Because the loom weights of Tell Mazar show differences in weight within the strata but also between the different estimated looms used in the Iron Age, it can be estimated that various kinds of textiles were produced. The relatively highweight of some of the Iron Age sets of loom weight suggests that vegetal yarns (linen or hemp) were produced on some of the looms.

Chapter 8 Study of the excavated remains: Khirbet al-Mudayna

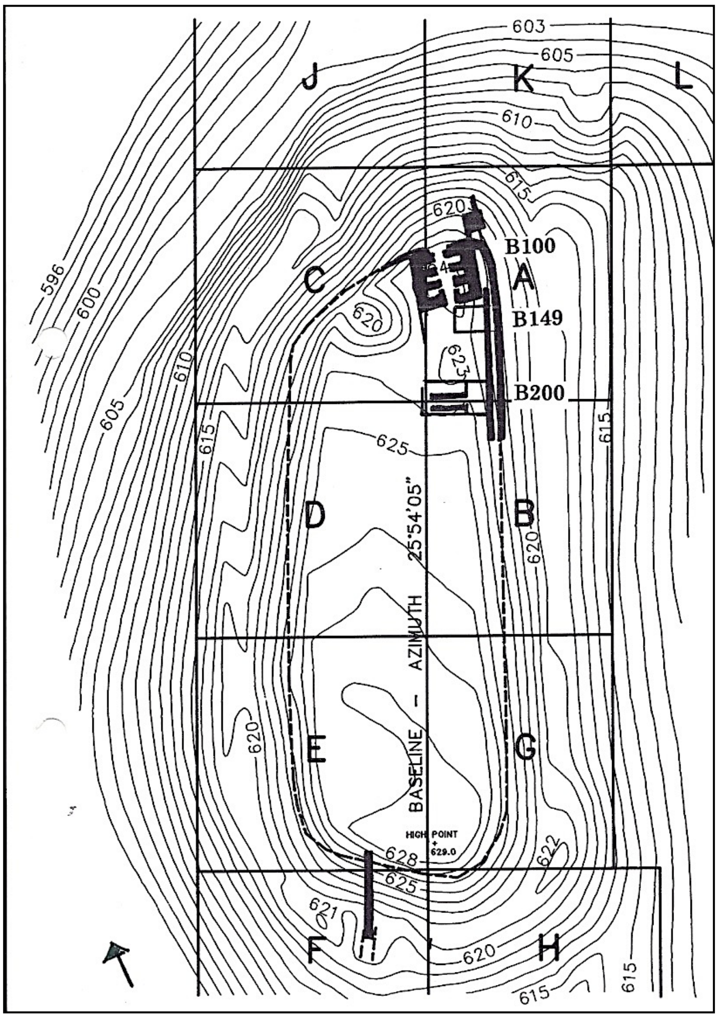


Fig. 8.1. Plan of Khirbet al-Mudayna (after Daviau and Dion 2002:33).

8.1 Introduction

Khirbet al-Mudayna is an Iron Age site in the Wadi ath-Thamad, on the northern border of ancient Moab in Jordan (map. 1.1). The excavation is part of the Wadi ath-Thamad Project run by Wilfrid Laurier University, Waterloo, Canada, which started in 1995 under the direction of P.M. Michèle Daviau. In addition to the excavation at Khirbet al-Mudayna, the project involves a survey of the area around the tell and excavations of an Iron Age shrine site, a nearby Nabataean settlement and a Roman fortress. The project was designed to investigate the distribution of Iron Age sites and to situate Khirbet al-Mudayna in its regional context (Daviau et al. 2006; Daviau and Chadwick 2007).

Khirbet al-Mudayna is a small site on the northern Moabite plateau, situated on the ancient border between Iron Age Moab and Ammon. Khirbet al-Mudayna on the Wadi ath-Thamad is located on the Palestinian Grid at 236.220 east 110.920 north, number 2311.014 j.n.

Khirbet al-Mudayna is the northernmost of six sites in south central Jordan that share the name Khirbet al-Mudayna (Miller 1989; Daviau 1997:222; Daviau 2001:1). It was a fortified compound measuring 140x80 m with casemate walls and a huge six-chambered gate protected by a tower (Chadwick, Daviau and Steiner 2000:261). The gate is comparable to gates found at Megiddo, Hazor and Gezer in Israel. Behind the gate there is an open plaza and a broad road leading into the settlement. To the east of the plaza is a temple complex. The temple (building 149) was a small

shrine 5.50x5.50 m, situated 2.50 m south of the gate complex. The building was identified as a shrine because of its architecture, but more important because three limestone altars, one with a complete inscription, a lamp and specialized artefacts were found in situ within the room (Dion and Daviau 2000; Daviau and Steiner 2000:1). Three pillared buildings have so far been excavated, with large basins and grinding installations used for industrial purposes, possibly textile production (Daviau et al. 2006). To the south of this complex at the east side of the road is a cistern and three pillared buildings (fig. 8.27). The entrances to the different buildings associated with the temple and the pillared buildings are alongside the road, they are shaped as a bent axis protected by a wall, possibly to protect the entrances from the rainwater running along the road.
The walled settlement, the building of which has provisionally been dated to the end of the 9th century BC, was attacked and burned down at the end of the 7th or in the 6th century BC. It may have functioned as a fortress guarding the eastern border of ancient Moab or – as proposed by the excavator – as a centre for textile production, or both (Daviau et al.2006). To investigate whether textile production is one of the main reasons for the existence of Khirbet al-Mudayna (Daviau and Chadwick 2007:310-312), the excavated material associated with textile production will be studied in this chapter. My research focused on the loom weights and the actual textile remains from the settlement. As far as possible, other objects associated with textile production, such as spindle whorls, pins and spatulas, have also been investigated.[97]

8.2 Textile remains and basketry from Khirbet al-Mudayna

Very rare and interesting fragments of textile have been found at Khirbet al-Mudayna. There are no comparable finds from Moab, while in the wider region, the southern Levant, only some textile remains have been documented and published. Chronologically close are the finds from Tell Deir Alla (Vogelsang-Eastwood 1989; Boertien 2004), Kuntillet Ajrud (Sheffer and Tidhar 1991), and Kadesh Barnea (Shamir 2007) – see also Chapter 5. All of the textile finds at Khirbet al-Mudayna are associated with use in some kind of storage. The actual textiles are not connected to personal use, clothing or furnishing. None of the carbonized textile fragments or the impressions is directly associated with artefacts used for the production of textiles, such as spindle whorls or loom weights.

a) Fragments of woven cloth
MT1265, from A10:12/16 (room 201 in pillared building 200).
These are the carbonized fragments of a woven cloth, retrieved from inside a ceramic cup. Once the cloth covered the contents of the ceramic cup. Most of the fragments have since turned into an unidentifiable powder.
Fragment 1. Measuring 22.59x18.39 (-15.02) mm
Fragment 2. Measuring 9.87x9.90 mm
The textile fragments are made of wool woven in a plain tabby weave with 12 threads p/cm in the weft and 16 threads p/ cm in the weave. The thread is a single S-spun yarn, with a diameter from 0.41-0.52 mm. No selvedges are visible in the fragments.

[97] Only the loom weights and textile fragments have been studied by the author. Further information is taken from the artefact lists and field reports kindly provided by the excavator Michele Daviau.

Fig. 8.2. Saving the textile fragment MT1265.

Fig. 8.3. Textile fragment MT1265 (scale in mm).

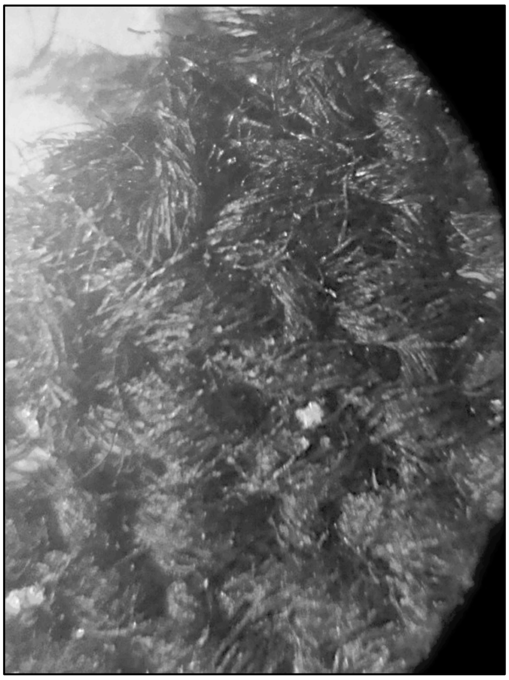


Fig. 8.4. Textile fragment MT1265 enlarged 10x.

b) Linen thread

MT (no. not recorded) (2006) from E69:6/10 (southernmost area of the site).

Two carbonized threads were found inside the holes of two sherds that belonged to one and the same pot (Daviau and Boertien forthcoming 2013):[98] sherd A, hole # 2 and sherd C, hole #1. The diameter of the holes is 0.04 cm, and the holes are 2 cm apart. The thread from both sherds is identical; it is made of bast fibres, and the structure (S-spun) and shape of the thread points to flax.

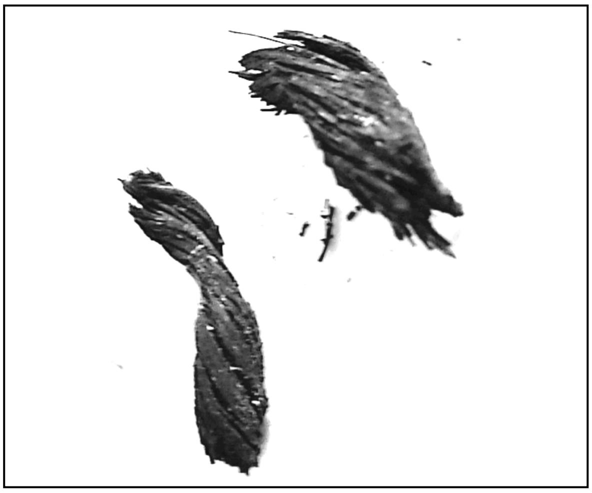


Fig. 8.5. Linen thread fragments found in E69:6.

The linen thread is S-spun measuring 1.26 mm in diameter; the threads have been Z-plied resulting in a total thread diameter of 2.52 mm.[99] The longest fragment is 30 mm. The threads are

[98] The author did not see the pottery sherds. The thread and the drawings of the sherds were kindly supplied by the excavator Prof. Daviau.

[99] Linens from dynastic Egypt are invariably S-spun (Barber 166). Bellinger found that the S direction is the natural twist of vegetable fibre. She concluded that for this reason the ancient Egyptians spun their linen thread in this direction (Bellinger 1950:1).

damaged and the plied structure has fallen apart, but the twisted structure of the threads is still visible. It shows that the threads were plied together.
From the description and the drawings it is not clear whether the holes were made in the pot before firing, or later perhaps after the pot was broken. According to the excavator the threads were possibly used as repair, which is not very plausible as linen threads are soft and would wear out on the sharp edges of the holes in the pottery. These linen threads would never have been able to restore the pot to its original shape and function.

c) Basket plaited with linen thread
Numbers MT1700 – MT1703 belong to the same artefact, a basket or a flat basket plaited with linen thread.

Fig. 8.8. Carbonized fragments of linen thread and carbonized reed fragments MT1700.

MT1700 (2005) from A30:32/62 (room 131).
Carbonized and extremely damaged fragments of linen thread S-spun and Z-plied. Varying in length and in thickness.
Fragment 1. Not plied. Length 28.69 mm, thickness 2.00 mm
Fragment 2. Not plied. Length 10.29 mm, thickness 1.76 mm
Fragment 3. Plied. Length 25.56 mm, thickness 4.35 mm
Fragment 4. Plied. Length: 24.13 mm, thickness 7.95 mm
Fragment 5. Plied. Length 15.12 mm, thickness 2.47 mm
Fragment 6. Plied. Length 2.70 mm, thickness 2.22 mm

Fig. 8.6. Carbonized linen thread fragments MT1700.

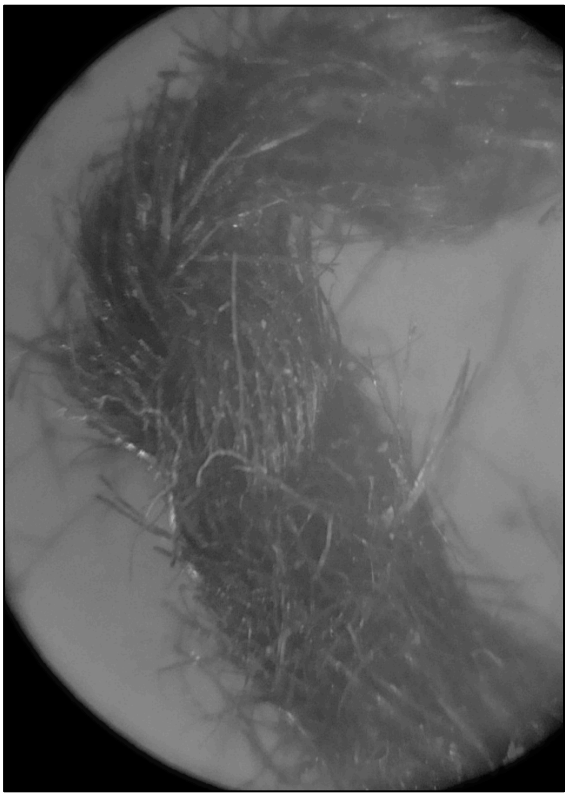


Fig. 8.7. Thread MT1700 10x magnified.

MT1701 from A30:34/65 (room 131).
Carbonized fragments of linen thread with some carbonized reed fragments. Material and technique as in samples MT1700, MT1702 and MT1703. Linen thread S-spun and Z-plied; the thread is 2.00-2.55 mm in diameter, the plied thread is 4.00-5.08 mm in diameter. There are many different fragments of thread. The longest fragment is bent (left on the picture fig. 8.9) measuring about 30 mm. The largest reed fragment can be seen on the picture (fig. 8.9) measuring (maximum) 9 mm in diameter and 35 mm in length.

MT1702 from A30:35/71 (room 131).
Carbonized basketry plaited with textile fibre. Material and technique as in samples MT1700, MT1701 and MT1703. The fragment measures 57.42x41.23 mm to 14.10x13.24 mm. The fragment consists of bunches of reed formed into a coil, 13.32 mm high and 12.19 mm thick. The coils are plaited with linen thread, using sixteen threads of 2.03-2.54 mm in diameter on a coil measuring 40.69 mm in length. The linen thread is S-spun and Z-plied.

Fig. 8.9. Linen threads with reed fragments MT1701. The bent thread fragment on the foreground is about 3 cm long, the diameter is 4.00-5.08 mm. The upper reed fragment is no more than 9 mm in diameter and 35 mm long.

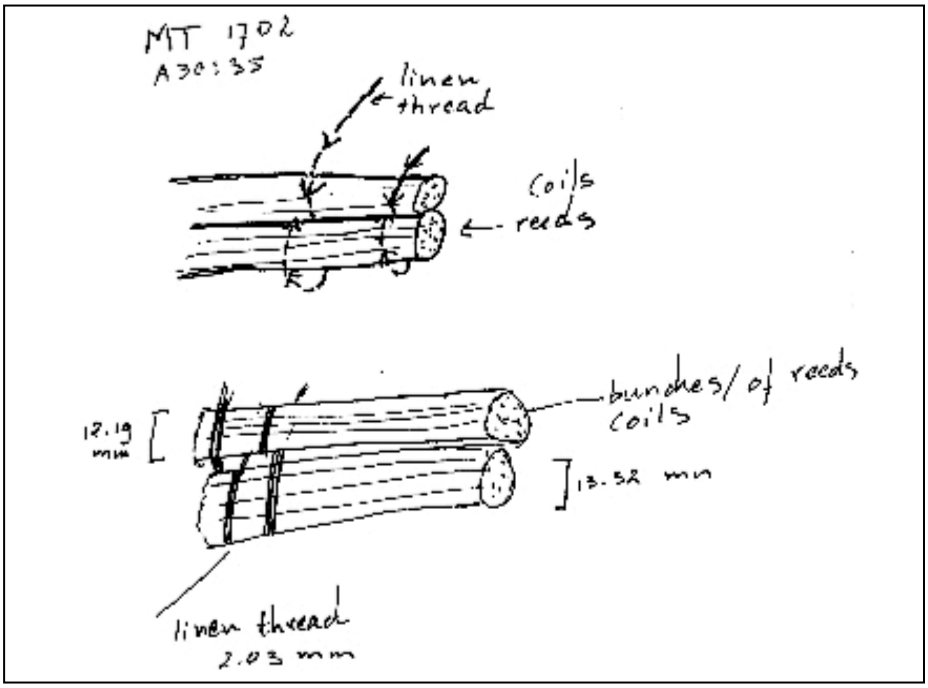


Fig. 8.10. Structure of the basket: coils of reed plaited with linen thread.

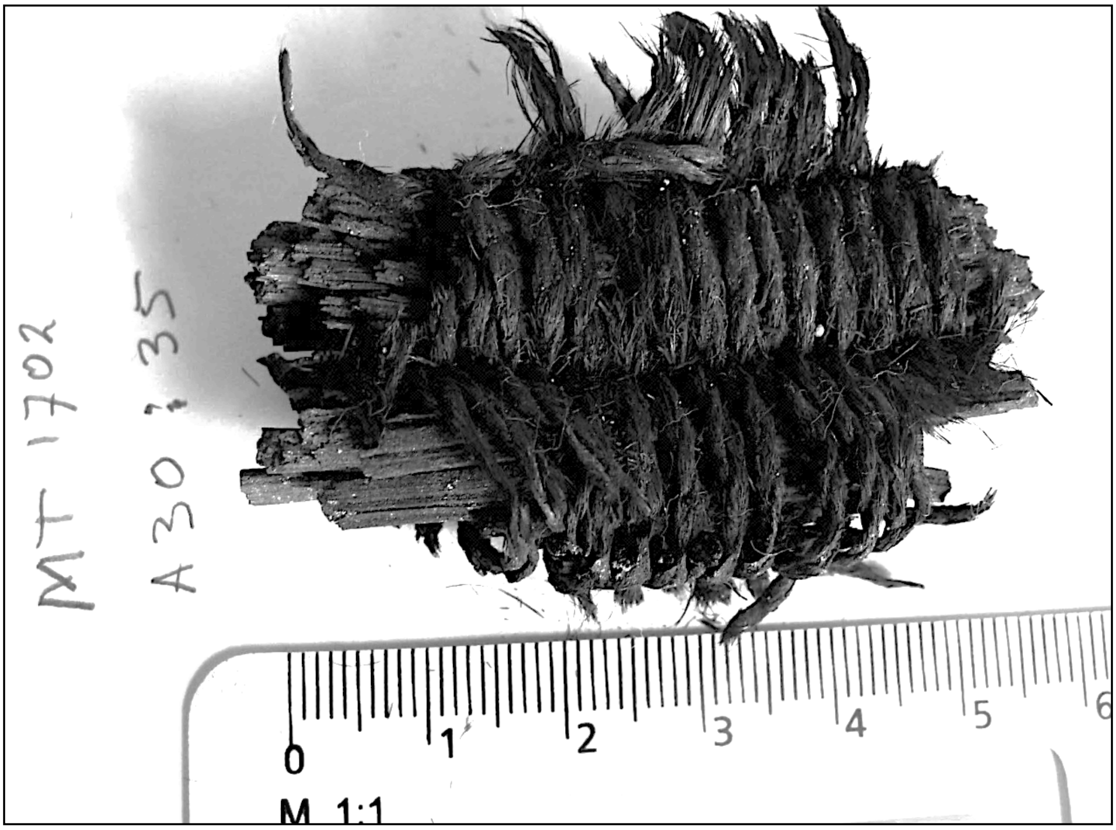


Fig. 8.11. Basketry plaited with linen yarn MT1702.

MT1703 from A30:34/66 (room 131).
Carbonized coil of reed plaited with linen threads. Material and technique as in samples MT1700, MT1701 and MT1702. The linen thread is S-spun and Z-plied, and 2.03-2.54 mm in diameter.

Fig. 8.12. Basketry plaited with linen thread (MT1703). The thread is 2.03-2.54 mm in diameter.

d) Basketry

MT1698 (2005) from B21:16/38 (pillared building 2005).

The find consists of several carbonized fragments of basketry. The largest fragment (no.1) is a very fragile interwoven piece consisting of four pieces of reed measuring 4.06-4.50 mm in diameter and forming a curved fragment, 11.22 mm wide. Each of the four reeds is about 2.5 mm wide.

There are also several fragments of reed that are not interwoven, varying in length and diameter.
Fragment 2. Length 41.53, diameter 17.81 mm
Fragment 3. Length 32.81, diameter 8.37 mm
Fragment 4. Length 14.79, diameter 9.75 mm
Fragment 5. Length 66.86, diameter 5.88 mm
Fragment 6. Length 35.92, diameter 5.88 mm
Fragment 7. Length 63.16, diameter 1.53 mm
Fragment 8. Length 47.38, diameter 1.60 mm
The basketry was possibly associated with the twisted rope MT1707 (below) found in the same layer.

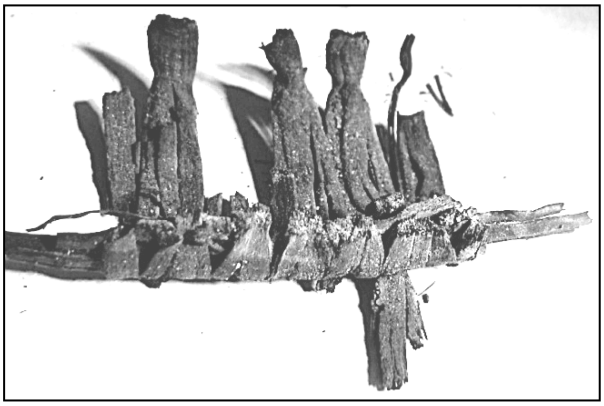


Fig. 8.13. Basketry MT1698, fragment 1, showing the outside of the fragment (2.5x enlarged).

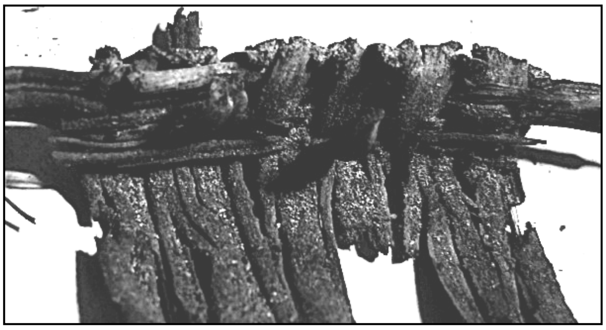


Fig. 8.14. Basketry fragment 1 (MT1698) showing the inside of the fragment (3x enlarged).

e) Twisted rope

MT1707 from B21:16/38 (pillared building 2005).

Carbonized twisted rope fragments made of vegetal material. Because the thread/rope is Z-spun and S-plied, it is supposed to be hemp and not linen. The natural twist of hemp is in the Z-direction and that of linen in the S-direction. The rope is plied with two threads varying in diameter between 2.97–2.07 mm into a rope with a maximum diameter of about 7 mm.

Fragment1. Length 35.02, thickness 2.97 mm
Fragment 2. Length 27.68, thickness 2.27 mm
Fragment 3. Length 30.40, thickness 2.92 mm
Fragment 4. Length 42.55, thickness 2.94 mm
Fragment 5. Length 27.86, thickness 2.07 mm
Fragment 6. Plied. Length 46.97, thickness 5.02 mm
Fragment 7. Plied. Length 52.18 mm thickness 6.86 mm

The rope fragments probably served as handles to the basket MT1698 (above) found in the same layer.

Fig. 8.15. Twisted rope MT1707.

Charred remains of a woven mat were found in the gate area. The fragments were scattered across the floor of Room 152. The material has been published (Chadwick, Daviau and Steiner 2000: 260-261, fig. 3).

8.3 The loom weights

A total of 278 loom weights have been registered at Khirbet al-Mudayna. For several reasons 28 of the registered loom weights were unidentifiable, resulting in a collection of 250 loom weights from different squares to be studied. The majority of the loom weights from Khirbet al-Mudayna are donut-shaped unfired clay loom weights. The average weight of a loom weight from Khirbet al-Mudayna is 269 g.

Type	Average weight
Donut-shaped	214 g n=87
Spherical	241 g n=19
Mixed	172 g n=14
Conical	545 g n=5
Cylindrical	172 g n=5
Anchor	Damaged n=1
Total	*268.8 g n=131* [100]

Table 8.2. Loom weight types and their average weights.

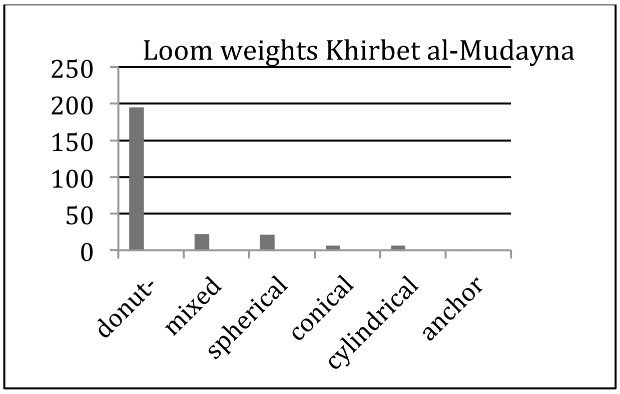


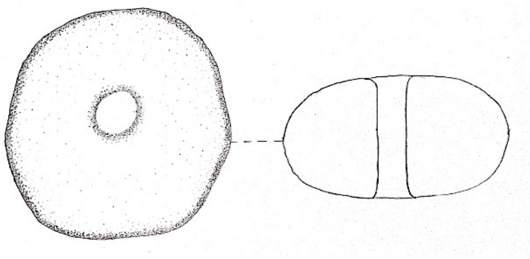
Fig. 8.16. The loom weights of Khirbet al-Mudayna (n=250).

The donut-shaped loom weights from Mudayna (fig. 8.17) are more or less identical in shape to those from other Iron Age sites in the southern Levant such as Kuntillet Ajrud (Sheffer and Tidhar 1991), Ta'anach (Friend 1998), Jerusalem, City of David (Shamir 1996), Rumeith (Chapter 9), Mudaybi (Wade and Mattingly 2002), Beth Shean (Shamir 2006), Deir Alla (Chapter 6) and Tell Mazar (Chapter 7). The conical and spherical loom weights are comparable to those described in Chapter 6. And the mixed types are a special group of loom weights that are described in Chapter 4.

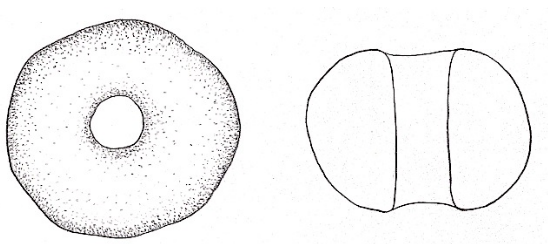
Type	Number	Percentage
Donut-shaped	193	77.2%
Mixed	23	9.2%
Spherical	21	8.4%
Conical	6	2.4%
Cylindrical	6	2.4%
Anchor	1	0.4%
Total	*250*	*100 %*

Table 8.1. The studied loom weights of Khirbet al-Mudayna (n=250).

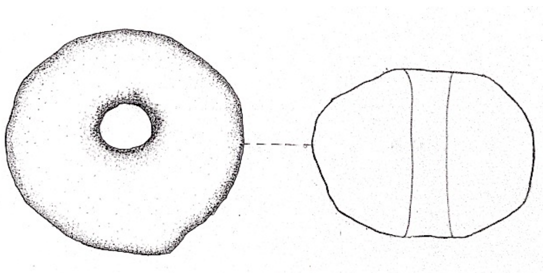
[100] Of the loom weights studied 119 items were damaged and could not be used to determine the weight (see website).



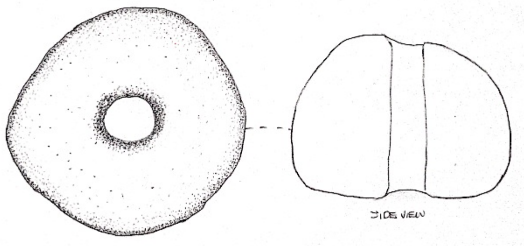
MT 2568 diameter 8 cm, height 4.3 cm weight 240 g, perforation 1.8 cm.



MT 2519 diameter 7.5 cm, height 4.9 cm, weight 254 g, perforation 1.9 cm.



MT 2691 diameter 7.7 cm, height 5.5 cm, weight 230g, perforation 2.0 cm.



MT 2627 diameter 7.9 cm, height 5.5 cm, weight 226 g, perforation 2.0 cm.

Fig. 8.17. Examples of donut-shaped loom weights from Khirbet al-Mudayna.

Fig. 8.18. Several donut-shaped loom weights from Khirbet al-Mudayna, building 2005. Bottom row second from right shows a more or less conical weight with a very large perforation.

Large groups of loom weights representing a loom

Because only a few field drawings or pictures were available showing the position of the loom weights when excavated, it was difficult to reconstruct looms. To determine if a group of loom weights belonged to one loom, the square and locus numbers were taken as selection criteria (see Chapter 4). The final selection was based on the field reports and loci descriptions; when loci were related, groups of loom weights from different locus numbers were considered to belong the same loom.

Thus five large groups could be defined, each representing a more or less complete loom. A *large group* of loom weights is a collection of loom weights containing more than ten weights.[101] Of the 250 loom weights studied, 156 weights (62.4 %) could be arranged within these five groups, with an average of 31 loom weights per group with an average total weight of 7115 g. The weight of the loom weights within the groups is 229.5 g on average (slightly less than the average over all the loom weights). These complete or near complete groups of weights, representing a loom, will be presented and discussed here; the small groups and isolated loom weights which were found scattered over the different areas of the tell are registered in the catalogue on the website.

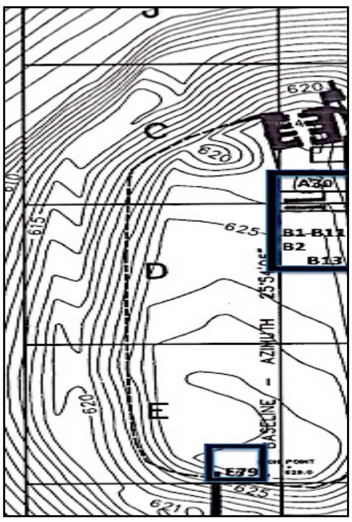


Fig. 8.19. Concentrations of loom weights were found in A30, B1, B2, B11, B22, B13 and E79.

[101] The choice of ten weights for such a group is based on the fact that this number enables weaving on a warp-weighted loom (see Chapter 4 and Boertien 2004:313, note 4).

Group 1

Room 131 in Building 145 in Area A. According to the excavator the construction and occupation history of Room 131 can be determined with a high degree of certainty. Its earliest occupation layer was founded on bedrock. On top of this foundation layer, three sequenced surfaces could be defined (A30:70, A30:72, and A30:68). From the occupation layer A30:67 on top of the floor, several caches of loom weights (fig. 8.21) were recovered, together with wooden remains of the burned loom itself, substantial fragments of a woven reed mat sitting on top of the wood and extending into other areas of the room, a spindle whorl, two complete pottery oil lamps, and a large number of polishing and pounding stones. The occupation ended due to a violent conflagration.

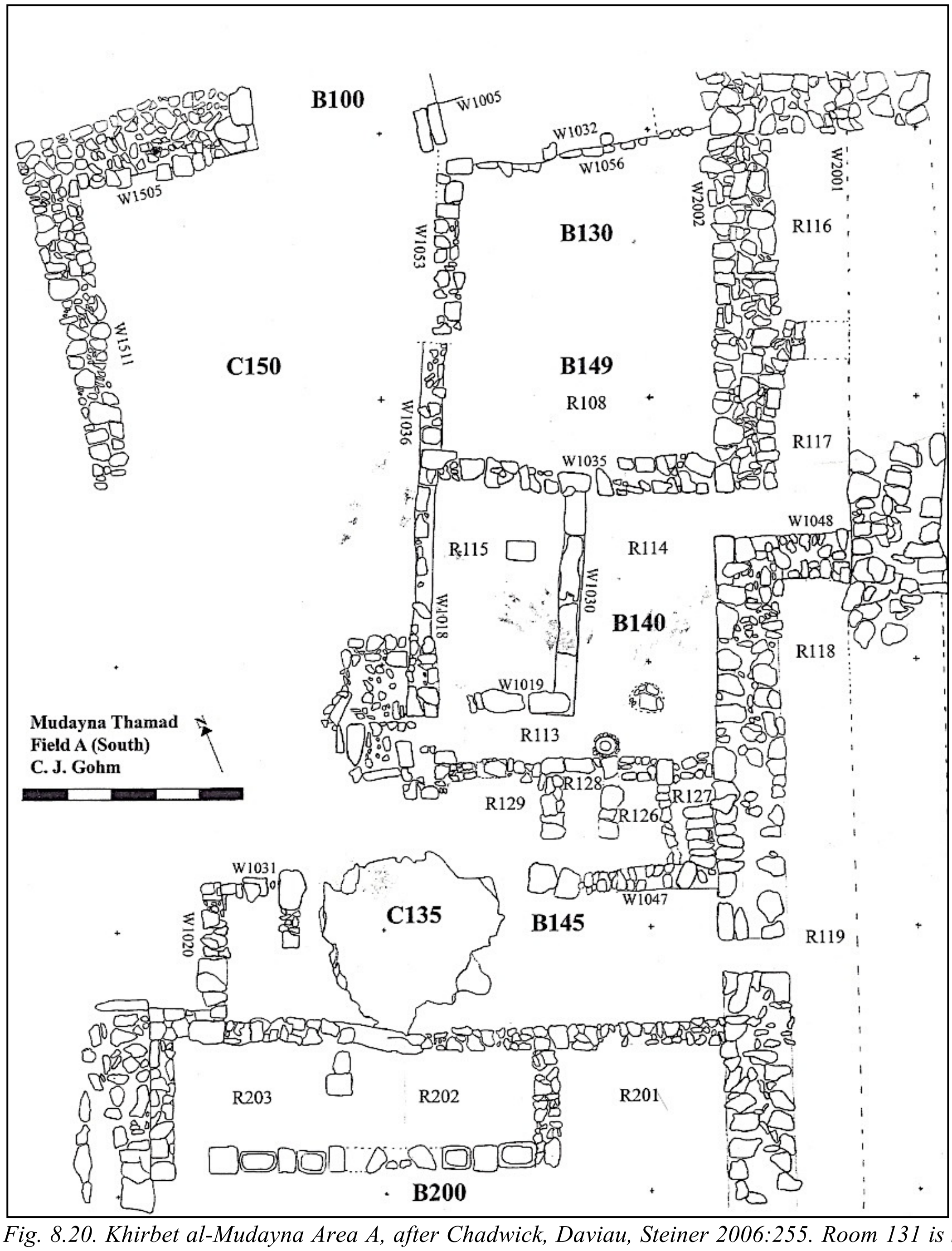


Fig. 8.20. Khirbet al-Mudayna Area A, after Chadwick, Daviau, Steiner 2006:255. Room 131 is situated in Building 145 to the north of Room 201.

Fig. 8.21. Room 131 with loom weights and charcoal.

From locus A30:67, 47 loom weights have been recorded (figs. 8.21 and 8.45), and from other loci in the same room several more loom weights have been found; it is difficult to figure out if they belonged to one and the same loom. The annual field report speaks of A30:65 as the debris layer on top of the floor, which contained some burned wood remains, fifteen loom weights, a miniature altar as well as grinding and polishing stones. From the plan drawn in the field (fig. 8.22) it seems that two different groups of loom weights were excavated, but only four of these weights were recorded in the object list and kept for research. The charred wooden beams were situated in the east side of the room. From A20:3 and 13, also belonging to the debris in room 131, four damaged donut-shaped loom weights have been recorded, but on the field drawing more weights are visible. These weights were possibly recorded as belonging to A30:67 (figs. 8.21 and 8.47)

Room 131 was situated in building 145, which was situated to the north of pillared building 200 and to the east of a depression. This depression is thought to have been a cistern. It is unknown whether the cistern was in use when building 145 and pillared building 200 were occupied. The precise function of building 145 and of room 131 could not be determined, but it is clear that a loom stood within the building. The loom weights in the middle of the room suggest that four rows of loom weights were used on this loom. The other group of loom weights does not show a specific arrangement (fig. 8.22).

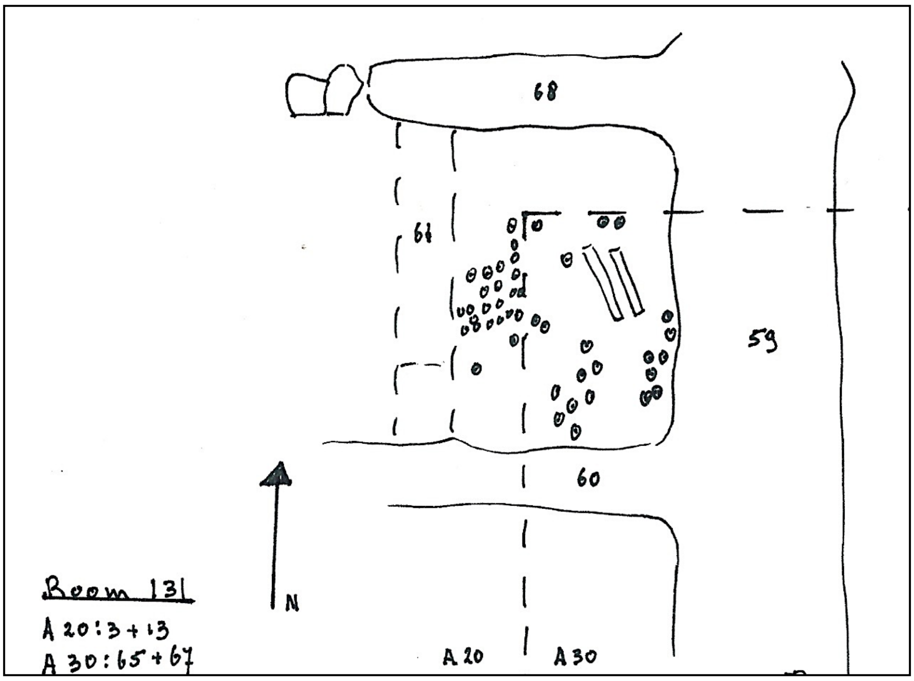


Fig. 8.22. Plan of room 131 (A30:65-67 and A20:3 and 13) scale 1:50. (See also figs. 8.21 and 8.45).

Four textile fragments were excavated in Room 131, and are described above: MT1700 (A30:32/62), MT1701 (A30:34/65), MT1702 (A30:35/71) and MT1703 (A30:34/66). These fragments belong to the same artefact, a basket or mat made of reeds, interwoven with linen threads. According to the field report the reed and textile fragment were found sitting on top of the loom weights, see further Chapter 8.2. One spatula (MT1222) was also found in this room, in connection with the loom weights.
The loom weights from the different loci in Room 131:

Locus A30:67 (fig 8.47)

Type	Number	Average weight	Average diameter	Average diameter of perforation
Donut-shaped	*33*	*231 g*	*6.9 cm*	*2.0 cm*
Spherical	*14*	*240 g*	*7.1 cm*	*2.0 cm*
Total	*47*	*235 g*		

Locus A30:65

Type	Number	Average weight	Average diameter	Average diameter of perforation
Donut-shaped	4	283 g	7.7 cm	1.9 cm

Loci A20:3 and A20:13

Type	Number	Average weight	Average diameter	Average diameter of perforation
Donut-shaped	4	---	7.0 cm	--

Table 8.3. Loom weights in loci A30:67, A30:65 and A20:3 and A20:13.

If the loom weights found in the debris layers are included, the total number of loom weights found in room 131 increases to at least 55. The plan (fig. 8.22) suggests that there were two separate groups, one in the southeastern corner of the room and the other in the middle of the room. All the loom weights from this room (and also the four from A20:3 and 13) will be regarded as being part of the same loom. The 55 loom weights in this group have a total weight of 13.897 g.

Type	Number	Average weight	Average diameter	Average diameter of perforation
Donut-shaped	41	257 g	7.2 cm	1.9 cm
Spherical	14	240 g	7.1 cm	2.0 cm
Total	*55*	*248 g*		

Table 8.4. Group 1.

Fig. 8. 23. The loom weights of Group 1.

Groups 2 and 3

Room 206 in Building 200, in Area B. Four rooms (R202, R203, R205, R206) in pillared building 200 were in some way associated with two parallel lines of limestone pillars and rectangular basins inserted between them in the central room (R205) (fig. 8.24). From the street, a line of plastered steps, supported by a wall on the eastern side, led into the central room. The floor of R205 was a beaten earth surface with very fine plaster applied to it, whereas in the side rooms R202, R203 and R206 the foundation of the building was set on sloping bedrock which had been partially worked to fit the architectural needs and was then filled in with cobbles and covered by plaster in order to create a level surface. The entire building was destroyed by a massive conflagration, which burnt the wooden support beams and the organic material associated with them.

Group 2 was found in Building 200, on the eastern side of Room 206, in two associated loci: B11:52 and B11:53. Locus B11:52 was ceiling material and contained a large amount of pottery as well as a piece of a carved ivory spindle, a pounder and 15 loom weights. Locus B11:53 is an ash and charcoal layer (burnt ceiling material, wood, etc.). It contained a large amount of pottery and bones, and 24 registered objects including an alabaster palette (fig. 8.46), a stone bowl, a door socket, a pounder, a grinder and seven loom weights. From these two loci 22 loom weights have thus been registered, with a total weight of 3730 g.

Type	Number	Averageweight	Average diameter	Average diameter of perforation
Donut-shaped	20	266 g	8.1 cm	1.8 cm
Unidentified	2	---		
Total	*22*	*266 g*		

Table 8.5. Group 2.

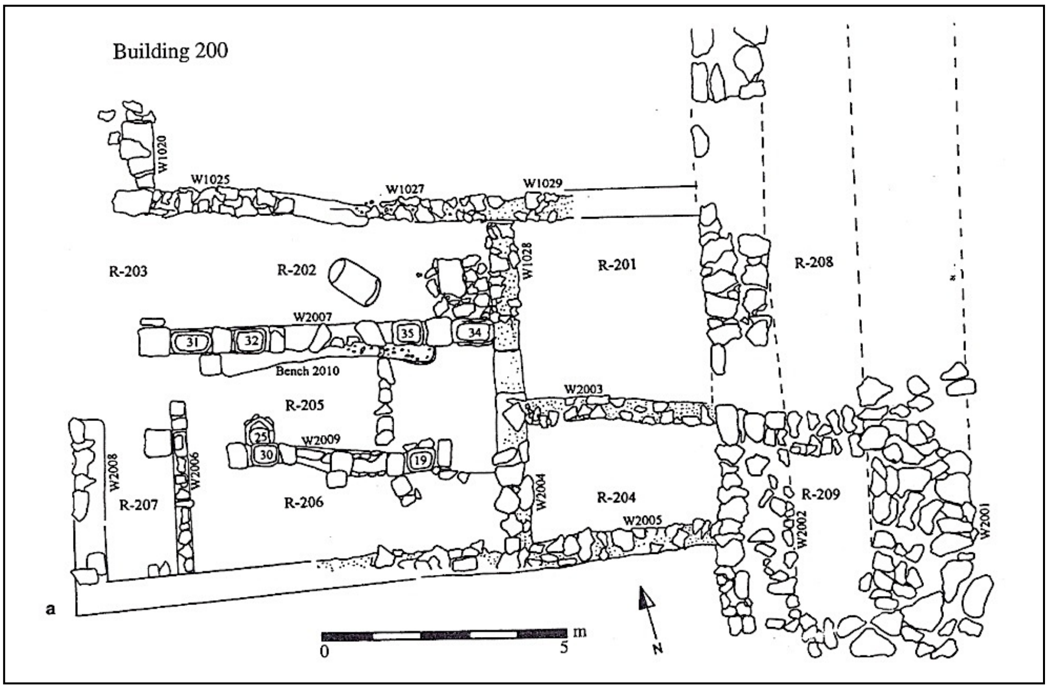


Fig. 8.24. Building 200 (after Daviau and Dion 2002:34).

Group 3

This collection was found at the western side of room 206 in Building 200. B1:38 revealed ten loom weights (one of which is MT843), analyzed by Loe Jacobs (see below), and a spindle whorl. This is a dark to black charcoal-filled soil layer which covered the entire square. Eight loom weights have been registered from locus B1:39. Locus 39 consisted of hard packed ceiling material; it lies on top of the eastern portion of locus 38. Pottery fragments and bones were scattered throughout loci 38 and 39. These eighteen loom weights had a total weight of 3537 g.

Type	Number	Average weight	Average diameter	Average diameter of perforation
Donut-shaped	*17*	*353 g*	*8 cm*	*2 cm*
Conical	*1*	*1045 g*	*8.3 cm*	*3 cm*
Total	*18*	*391 g*		

Table 8.6. Group 3

All these loci most probably belong to the same depositional layer, the destruction of the building and the collapse of an upper floor. A total of 40 loom weights were thus registered from Room 206. Bearing in mind that an average loom uses about twenty to thirty loom weights, two looms might have stood in this room, one at its eastern and the other at its western side. The existence of one large loom using 40 or more loom weights should also be considered. Such large amounts of weights belonging to one loom have been found in Iron Age Tell Deir Alla (this volume Chapter 6; Boertien 2004:32), Tell Mazar (this volume Chapter 6; Yassine 1988 pl.VII, VIII and IX) and at Tell es-Saidiyeh (Pritchard 1985:35-36). At these sites the weights were found in situ and the photographs and drawings show that the loom weights were used in two or more rows, which is an indication that pattern weaving took place (Boertien 2004:320).

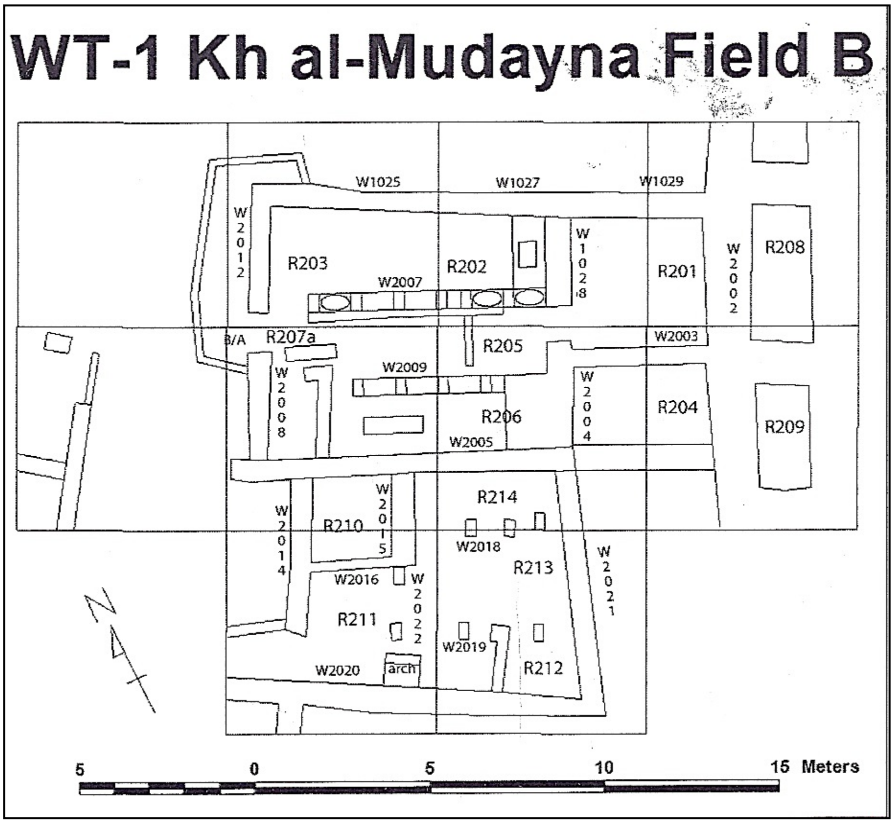


Fig. 8.25. Schematic plan of field B, showing building 200 and 205 (Daviau, Chadwick, Steiner 2006:257).

Group 4

Building 205, Room 211 (B2:10,11,12 and 14) in Area B (fig. 8.25).

Building 205 was oriented west to east and shared a wall (2005) with Building 200. In the centre of building 205, three parallel rooms (R112, R113 and R214) were divided by two rows of pillars. Rooms 213 and 214 were both roofed; in the roof debris a decorated limestone *worktable* (MT 2330) and a large roof-roller (MT2326) were found (both on display in the Madaba Archaeological Museum). While the southern room (R212) contained very little pottery, the northern room (R214) yielded a very high concentration of mostly utilitarian pottery (cooking pots, jugs, etc.), as well as oven fragments and a thick layer of ash.

Room 211 was situated in the southwestern corner of the building. The floor of this room was composed of flat stones and plaster. From the floor a large quantity of bones, burnt stones and some pottery, two door sockets (MT1239 MT 1242) and a basalt millstone (MT1251) were recovered. In the compact soil above the floor pottery was frequent and the following artefacts were found: a zoomorphic ceramic figurine (MT1114), two basalt grinders (MT1149, MT1175), a grinding stone (MT1250), a limestone basin (MT1207), a limestone spindle whorl (MT1148) and a number of loom weights. The position of the loom weights has not been reported and no photographs or drawings were available.

The loom weights possibly represent a loom, and the total weight of these loom weights is 3917 g.

Type	Number	Average weight	Average diameter	Average diameter of perforation
Donut-shaped	30	165 g	7.5 cm	1.7 cm
Spherical	2	236 g	6.8 cm	1.8 cm
Mixed	3	188 g	6.2 cm	1.6 cm
Unidentified	4	unknown		
Total	*39*	*197 g*		

Table 8.7. Group 4 in Building 205, Room 211, B2:10,11,12 and 14.

Four spatulas have been found in B22:29 and 33. In B 22:29 a jar-stopper (MT 2490) showing textile imprints was also found (see below and fig. 8.43). The locus numbers differ from the find spot of the loom weights, but the spatulas may have been in storage, to be used perhaps even on this particular loom.

Group 5

Building 210 in Area B, (fig. 8.27). Building 210, another pillared building, is located in squares B3, B13, B23. It is a tripartite building with two parallel rows of pillars and basins. Although the layout of B210 resembles that of B200, it is also important to note dissimilarities. The rooms R221, R222, and R223 extend from the entrance of the building to the casemate wall (W2002). There are no back rooms as in Building 200. The central room of B210 (R222) is the narrowest room in the building, while both the north (R221) and the south (R223) rooms are significantly wider. That is not the case in B200.

Room 221 is the northernmost room of the building. From the western side of this room 22 loom weights have been registered from different loci. An astragalus (see below and fig. 8.41) and burnt wooden beams have been excavated from the same room, apparently the remains of a loom that stood in that area. Loom weights were completely absent from the eastern side of the room, therefore we can assume that weaving only took place in the western part of the room. The total weight of this set cannot be given because all the donut-shaped loom weights are damaged.

Type	Number	Average weight	Average diameter	Average diameter of perforation
Donut-shaped	13	unknown/damaged	7.7 cm	1.5 cm
Mixed	9	196 g	--	--
Total	*22*	---		

Table 8.8. Group 5.

Small groups of loom weights in B210

Several smaller groups of loom weights were also found in Building 210. Room 222 is the central room of building B210, with a floor of packed soil. According to the excavators, R222 is characterized by a paucity of artefacts and pottery finds and is therefore referred to as *a high traffic area*. The artefact list shows that three loom weights were excavated from this room in locus B13:117; two donut-shaped ones and a mixed form.

The southern part of Building 210 consisted of two rooms: R223 and R224. The western room 223 had a cobbled/flagstone floor, while the eastern room 224 had a plaster/clay floor. Other artefacts and pottery were almost completely absent from this area. Two donut-shaped loom weights and a burnt beam have been registered from B13:124, which is an ash and plaster layer on the floor of room 224. And in Room 223 (B13:18 and 55) four spatulas have been found, as well as the worktable MT2329.

Loom weights in the gate

Several loom weights were found in the area of the six-chambered gate. There was a small group of six loom weights in Room 151, found in different loci: two in C95: 8, three in C95:15, and one in C95:18. An additional donut-shaped loom weight was found in C93:9 to the north of the gate area. It weighs 250 g and measures 4.15 cm in diameter. In this locus the cloth-wrapped substance was also found (see below). The weight of most of the loom weights from the gate area is unknown because they could not be studied by the author. The information has been taken from the reports and the artefact lists kindly supplied by the excavator. There is no information available about the circumstances in which they were found. The excavators supposed that the loom weights were kept in storage in the upper story of the western gate chambers R151, R152 and R153 (fig. 8.27).

Type	**Number**	**Average weight**	**Average diameter**	**Average diameter of perforation**
Donut-shaped	5	unknown	4.6 cm	1.7 cm
Donut-shaped	1	250	4.15	unknown
Unidentifiable	1	--		
Total	7			

Table 8.9. Loom weights from the gate area C95:8, C95:15, 18 and in C93:9.

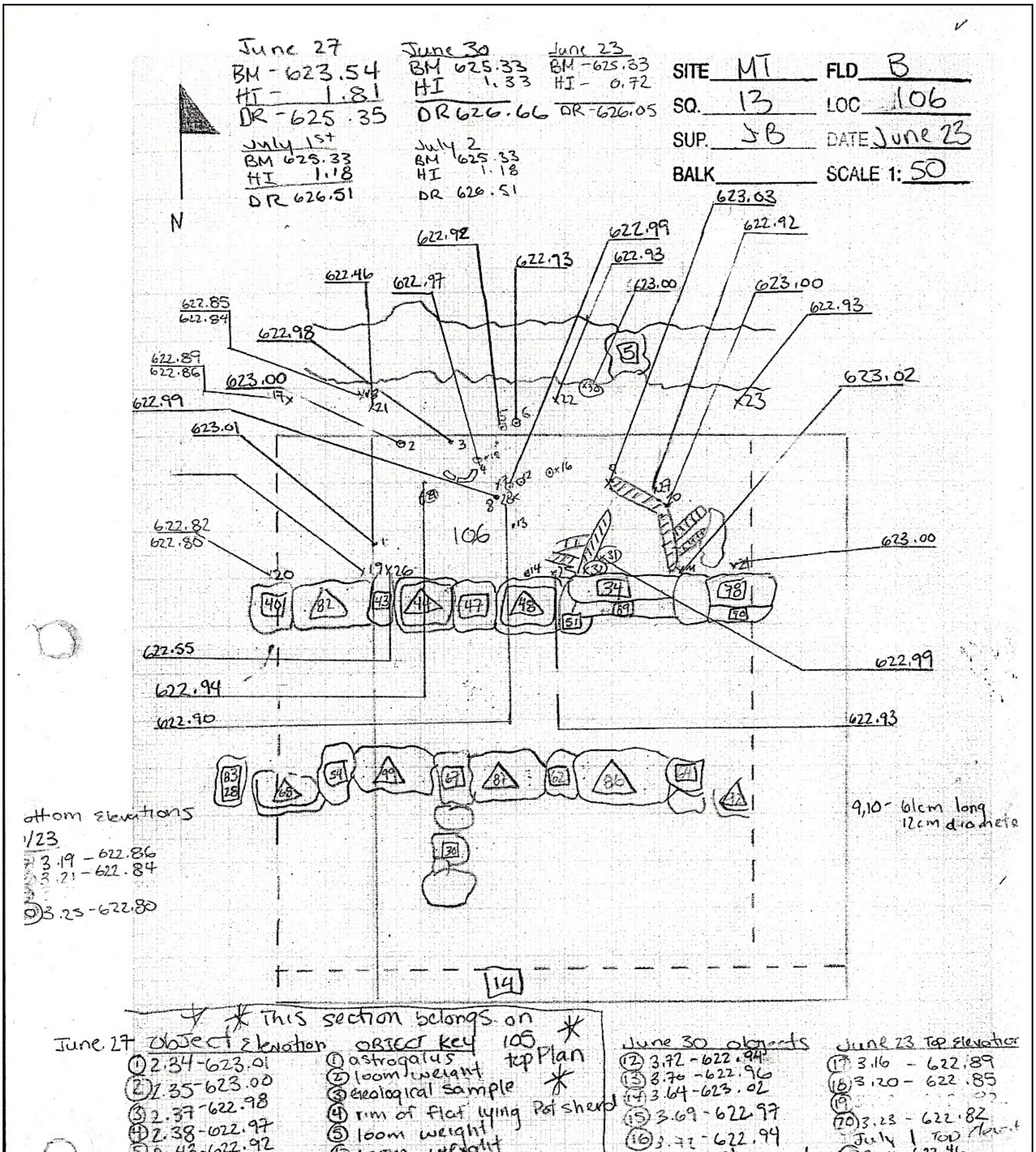


Fig. 8.26. Plan of B13:106, field drawing of the find spot of group 5. It shows the location and the level where the loom weights and the burnt beam were found.

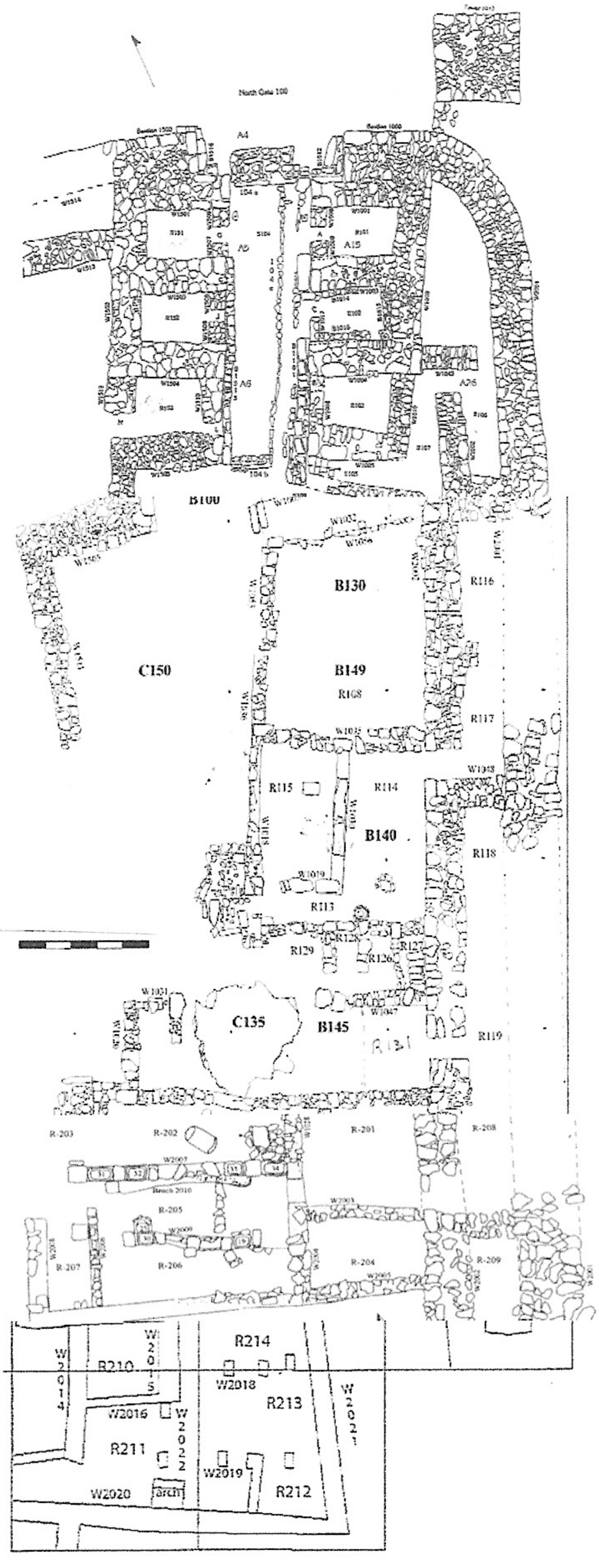
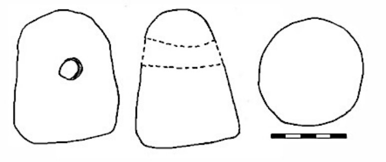
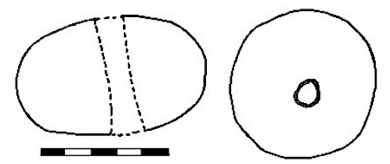
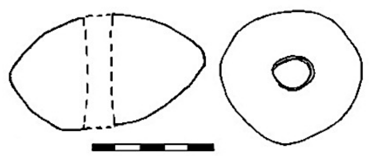
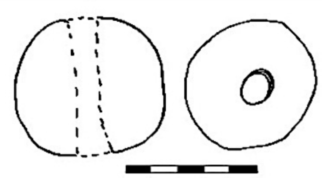
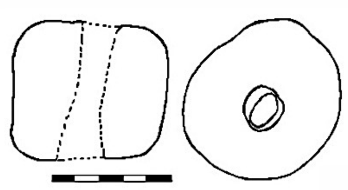


Fig. 8.27. Khirbet al-Mudayna overview (Area A and B). (After Daviau and Steiner2000:3; Chadwick, Daviau and Steiner 2000:259; Daviau and Dion 2002:34; Weigl 2006:259).

Horizontal perforation (pendant)

Conical loom weight 	*Conical loom weight* a. Characteristics: Conical body with a circular or elliptical base. Diameter of the perforation varies from 0.5 to more than 2 cm.
Anchor-shaped loom weight 	*Anchor-shaped loom weight* Characteristics: height exceeds diameter, body and base elliptical or more or less flattened rectangular with rounded top with flat ends. Perforation diameter varies, usually over 1 cm.

Central perforation

Donut-shaped loom weight  a  b	*Donut-shaped loom weight* *Characteristics:* the weight was made from a coiled piece of clay < 9 cm, the coil was wound around the finger to create the shape. a. Donut-shaped loom weight (regular). Characteristics: less than 9 cm in diameter. Width 1 cm wider than height. Perforation diameter 1-2 cm. b. *Biconical weight.* A donut-shaped loom weight. The elliptical shape is non-discriminating, and the weight was made in the same way as the donut-shaped weight, resulting in identical characteristics: less than 9 cm in diameter. Width 1 cm more than height. Perforation diameter 1-2 cm.
Spherical loom weight 	*Spherical loom weight* Characteristics: width and height vary no more than 1 cm. Ball-shaped loom weights are over 5 cm in diameter. Perforation diameter over 1 cm.
Cylindrical loom weight 	*Cylindrical loom weight* Characteristics: width and height vary no more than 1 cm, flat ends. Perforation diameter over 1 cm.

Typology of perforated clay loom weights from Khirbet al-Mudayna Iron Age IIc 7th-6th century BC.

The fabrics of the loom weights
An analysis of seven clay loom weights from Khirbet al-Mudayna was performed by Loe Jacobs, the potter of the Laboratory for Ceramic Studies at Leiden University. Jacobs compared the clay of the loom weights with the clay used in the pottery of Khirbet al-Mudayna, which was also analyzed by him (Steiner 2006). He delivered the following report on the loom weights.

"After a visual inspection of all the twelve samples, seven samples were selected for further analysis. Originally these clay loom weights were not fired, which indicates that originally they were not meant to be used in contact with water. Therefore they could be broken relatively easy with low force. From the selected samples a small piece was removed and re-fired to a temperature of 800 ºC under oxidizing circumstances. It was observed that about half of the re-fired samples showed a red firing-colour, while the others fired to a buff colour. The red firing clays would have been suitable for making pottery after the correct preparation. They probably did contain a substantial amount of real plastic clay. This gave them two valuable properties, which are necessary for making pottery. In the first place clay suitable for making pottery should contain enough plastic material. The presence of fine grains is not enough and many silty soils are therefore unsuitable for making pottery. Only the soils that contain enough real clay are of interest for potters. Very silty soils can be used for making other objects however, like mud bricks and clay weights. They can also be of value for plastering and building.

Seven loom weight-samples have been analyzed:

MT1058	Re-firing colour at 800º C oxidizing: buff. Munsell 10YR 7/3 (very pale brown). The clay was unsuited for making pottery; it was too weakly bound and dissolves in water.
MT843	Re-firing colour at 800º C oxidizing: Munsell SYR 6/6 (reddish yellow) with fine iron oxide. Contains some grains of gypsum (about 5 %). Very loose crumbly structure, not suitable for making pottery. Contains about 5% volume of fibres.
MT1198	Re-firing colour at 800º C oxidizing: buff. Munsell 10YR 7/3 (very pale brown). Unsuited for making pottery, with a very loose structure. Containing grains of limestone. No ostracoda.
MT1426	Re-firing colour at 800º C oxidizing: buff. Munsell 10YR 7/3 (very pale brown). Rather weakly bound, but suitable for making pottery. It contains grains of limestone and some organic fibres. No ostracoda. This is the only buff coloured clay that fires to a suitable quality. The fabric can withstand water and has enough binding power.
MT1062	Re-firing colour at 800º C oxidizing: reddish yellow. Munsell SYR 6/6 (reddish yellow), with fine iron oxide. A clay suitable for making pottery, containing some limestone grains (about 5 %) and some very fine muscovite.
MT1413	Re-firing colour at 800º C oxidizing: reddish yellow. Munsell SYR 6/6 (reddish yellow), with fine iron oxide. A clay suitable for making pottery, containing some grains of limestone (about 5 %) and some crystalline calcite. Organic fibres were added, about 5 % by volume and max. 5 mm in size.
MT1434	Re-firing colour at 800ºC oxidizing: reddish yellow. Munsell SYR 6/6 (reddish yellow). A clay with good firing properties, containing some limestone and about 5% crystalline calcite and with fine iron oxide. Organic fibres around 2 % by volume and max. 2 mm in size

Generally spoken two kinds of clay can be distinguished.

1. A reddish yellow clay, containing some fine iron oxide, sometimes with some muscovite, to which about 5% volume of fibre was added.
2. A buff to red firing clay containing grains of limestone and crystalline calcite, to which 2-5% of fibres were added. The clay is much less silty and more compact as a result the fabrics are much stronger.
It thus seems that different kinds of local clay were used to make loom weights, and that the clay used to make loom weights was not always suitable for pottery making.

When comparing the clays used to make pottery and loom weights two differences are visible.
1. The clays used in the Khirbet al-Mudayna pottery sherds that match with the buff firing colour in most cases do contain ostracoda. It is likely, however, that the ostracoda were added, or that clays were mixed with soil containing ostracoda. The loom weights did not show ostracoda because they were not meant to be fired.
2. In many cases the fired sherds contained fine organic fibres, which were added probably to improve the cohesive strength during forming.
These fine organic fibres are found in all the loom weight. Fine organic material in percentages between 2-5% were always added to the clay of the loom weights in order to improve the cohesive strength, not only during shaping, but also during use because the loom weights were made to be used in an unfired state."

Several loom weights showed various kinds of temper, such as limestone, flint, chert and basalt. One loom weight (no. 71, MT1071) shows a very special temper: small bone fragments could be seen in the clay and were also visible on the surface of the weight (fig. 8.28), this fact points to the use of temper from household rubbish. In pottery the choice of rubbish as temper indicates poverty because it is not pleasant to work with rubbish instead of a more convenient temper such as organic material (R. Cappers personal communication). On the clay and temper of loom weights, see also Chapter 4 of this study.

Fig. 8.28. Loom weight tempered with bone fragments (no. 71, MT1071, from B11:53). Diameter 7.2 cm, height 4.7 cm, weight 220 g, diameter of perforation 2 cm. The loom weight shows traces of use.

Wear in loom weights
Six loom weights (no. 33, MT1067; no. 49, MT985; no. 67, MT1054; no. 71, MT1071; no. 156, MT2571; no. 187, MT2452) showed signs of wear inside the perforation holes (figs. 8.28-8.30). These traces of use are comparable to those from Deir Alla phase IX (see Chapter 4.2 fig. 4.13, and Chapter 6.6 figs. 6.24 and 6.25) and Tell Mazar (see Chapter 7.3 and fig. 7.33).

Manufacturing traces
Signs of manufacturing such as fingerprints and traces of pressing the loom weight after perforation could be distinguished in eight of the loom weights (fig. 8.30). (A general description and the loom weights of Deir Alla can be found in chapter 4.2 figs 4.11 and 4.12 and Tell Mazar 7.3 fig. 7.31). In loom weight no. 171 (MT2458), the pattern of the stick used to perforate the loom weight can be seen. In five loom weights a double or partly double perforation can be seen. This can be regarded as a mistake; the weight could still be used in this condition.

Fig. 8.29. Donut-shaped loom weight showing signs of wear (no. 67, MT1054 from B2:11);
Diameter of the loom weight 6.6 cm, height 3.1 cm, weight 104 g, diameter of perforation 2.0 cm.

Fig. 8.30. Donut-shaped loom weight (no. 32, MT1073 from B11:53) showing traces of manufacturing.
Diameter of the loom weight 7.5 cm, height 4 cm, weight 202 g, Diameter of perforation 2.5 cm.

8.4 Spatulas

Spatulas (or laminas) are very thin, highly polished knife-like tools made from animal bone (often ribs), smoothed and highly polished while the point shows signs of wear. They are oblong and flat, between 10-12 cm in length, on average 1-3 cm wide, from 0.1-0.2 cm thick, with one sharply pointed end; the other is often more rounded. Spatulas acquire a polish, which can become a wax-like gloss; this gloss is more intense around the point. Experiments performed by Hella Hollander (unpublished Master's thesis Leiden University) have shown that the polishing resulted from contact with linen or woollen threads. The tool is known from various Iron Age sites – see Chapter 3.2. (See also Chapters 9.4 and 10).

A total of 17 spatulas have been registered at Khirbet al-Mudayna, although it is not always clear if the object is indeed a spatula or some other bone object. The author has not physically studied the spatulas; the information has been taken from the object lists. The spatulas were often found in the same square and in the same locus as loom weights. Because they are much lighter than loom weights, they may have been moved from their original position due to post deposition processes. From Room 131 (see figs. 8.20 and 8.22), where the loom of Group 1 was located, only one spatula has been registered. In building B200, where the loom of Group 2 stood, one more spatula was found. Square B22 building 205 yielded three spatulas, which may have been in storage for the loom of Group 3 in building B205. Four spatulas were found in building B210, where Group 4 was found. The other spatulas were found scattered over the excavation squares – see Table 8.10.

Square/locus	Length in cm.	Width in cm.	Thickness in cm	MT number
A10:13	7.15	0.70	0.05	1223
A30:28	12.20	2.0	0.12	1222
B11:0	9.40	1.50	--	704
B21:14	4.20	2.00	0.10	1562
B13:55	7.59	3.15	0.10	2345
B13:55	8.59	3.15	0.10	2347
B13:18	4.57	1.01	0.18	2318
B13:18	7.60	2.05	0.20	2321
B22:29	12.30	4.09	0.28	2467
B22:37	5.00	1.41	0.03	2560
B22:37	7.50	2.30	0.19	2574
C97:4	3.90	1.11	0.26	577
D81:32	3.95	2.46	0.52	2331
D61:17	9.80	3.81	0.31	2541
D62:19	6.96	2.59	0.14	2813
E88:23	9.80	1.30	0.28	2027
E89:35	7.50	2.20	0.10	1520
Total	17			

Table 8.10. Spatulas registered from Khirbet al-Mudayna N=17.

Conclusions

Spatulas were not essential to weaving as they were not meant to beat up the weft but were used to make coloured and/or intricate patterns. It is not possible to connect all spatulas directly with groups of loom weights, which is not surprising because spatulas were used in pattern weaving and not every loom was threaded to produce intricate patterns. The presence of spatulas together with loom weights suggests that some of the looms operated at Mudayna were indeed used to create a patterned weft. A future study of the small finds from Khirbet al-Mudayna, such as pins, awls and other objects made of bone, horn or ivory, may show which artefacts, besides the spatulas, were used on the looms.

8.5 Spindle whorls

At Khirbet al-Mudayna, 38 spindle whorls made of various materials and from different areas have been registered. The spindle whorls have not been studied in detail by the author, but the information presented below is taken from the artefact lists as recorded by the excavator.[102] Because these artefacts are essential for textile production (see further Chapter 2.2) they will be discussed below.

Square/locus	Material	Width in cm	Weight in grams	MT number
A4:68	limestone	4.9	fragment	1002
A6:15	ceramic	3.7	fragment	370
A8:6	unknown	2.4	100	337
A8:6	ceramic	4.1	fragment	328
A19:28	ceramic	3.8	110	1132
A19:69	limestone	5.0	076	1240
A20:13	limestone	5.5	050	169
A28:8	ceramic	9.0	100	830
A30:67	unknown	3.5	fragment	2592
B1:38	reworked sherd	9.0	100	852
B2:16	limestone	1.6	070	1148
B2:25	reworked sherd	4.9	090	1309
B3:12	limestone	3.5	060	1779
B3:37	ceramic	3.6	044	1964
B3:41	ceramic	3.8	090	1945
B11:52	ivory	13.3	072	1013
B11:61	limestone	4.7	fragment	1317
B21:14	ceramic	3.8	040	1521
B21:16	bone	fragment	fragment	1616
B21:16	bone	fragment	fragment	1618
B23:3	stone	4.0	072	2169
C94:3	limestone	5.9	190	752
C94:26	ceramic	3.6	040	766
D71:13	limestone	4.4	070	2189
D81:20	limestone	1.2	fragment	2212
D91:43	unknown,	4.1	090	2305
E78:44	bone	fragment	fragment	1969
E89:38	stone	3.3	070	1540
E88:2	limestone	2.2	060	1781
E88:3	reworked sherd	3.5	044	1810
E88:33	limestone	3.4	067	2125
E89:27	stone	fragment	fragment	1556
E87:9	ivory	4.2	fragment	2168
Total 33				

Table 8.11. Iron Age spindle whorls from Khirbet al-Mudayna N=38.

Material

Levantine Iron Age spindle whorls can be divided into two main groups: those made of pottery (ceramics) and those made of stone. Pottery spindle whorls are slightly convex discs made of reworked sherds; stone whorls are often dome-shaped and made of various kinds of stone – see further Chapter 2.2. (See also the spindle whorls from Tell er-Rumeith in Chapter 9. 2).

The Iron Age spindle whorls at Khirbet al-Mudayna were made of limestone, ivory, bone, ceramics and reused pottery sherds.

[102] The whorls themselves and detailed descriptions, drawings and photographs have not yet been studied. In future research a detailed study of the spindle whorls from Khirbet al-Mudayna is needed to confirm the information on the reported spindle whorls.

Fig. 8.31. Ceramic spindle whorl (MT830 from A28:8).

Material	Number	Weight (on average)	Width (on average)
Limestone/stone	14 whorls	56 g (ranging from 50-76 g)	3.8 cm (ranging from 1.2 to 5.5 cm)
Ceramic	8 whorls	53 g (ranging from 40-110 g)	4.4 cm (ranging from 3.6 to 9.0 cm)
Ivory	2 whorls	unknown	8.7 cm (ranging from 4.2 to 13.3 cm)
Reworked sherd	3 whorls	78 (ranging from 44-100 g)	5.8 cm (ranging from 2.4 to 4.1 cm)
Bone	3fragments	unknown	unknown
Unknown	3 whorls	unknown	unknown
Total	33		

Table 8.12. Iron Age spindle whorls from Khirbet al-Mudayna.

Measurements
The spindle whorls from Mudayna are heavy, ranging from 40-190 g; the average weight of a whorl is 80.5 g and the average diameter of the spindle whorls is 4.3 cm while the average perforation diameter is 6.2 mm (see also Chapter 9.2). It has been suggested that the width (diameter) of a whorl is important in combination with the weight because it indicates the moment of inertia, responsible for twisting the yarn (Verhecken 2010), which could be an indication of the kind of yarn spun. Regarding this question, the width and weight of the whorls from Mudayna have been studied (Table 8.12).
The categories of ceramic and limestone/stone whorls seemed to be relevant in number, but the results were disappointing because the interrelationship between width and weight within both groups is very close and no meaningful conclusions about what kind of yarn was produced can be drawn from these figures. The number of whorls is low, and as they are relatively heavy it can be concluded that a small amount of thick vegetal yarn and / or thick woollen yarn could be produced with the limited number of spindle whorls found at Khirbet al-Mudayna.

8.6 Other finds related to textile production
Several objects have been found at Khirbet al-Mudayna that were probably associated with textile production.

a) Objects made of stone, resembling loom weights.
Several stone rings resembling loom weights have been excavated from different find spots.
Four were made of limestone MT631 (A17:29), MT603 (A18:22), MT681 (L23:2) and MT631 (N34:0). Three were made of basalt MT624 (A17:29), MT763 (B11:2), MT 2152 (D91:25).

Two were made of chert MT2223 (D8:21), MT407 (B1:20). The stone objects were not found together with groups of clay weights, nor with spatulas or spindle whorls. It is impossible to conclude what the use or function of these objects was.

b) Stone basins
Several stone basins have been found at Khirbet al-Mudayna, mostly within the various pillared buildings B200, B205 and B210. Some of the basins were situated between the pillars and incorporated in the plaster of the floor forming part of the architectural construction of the pillared building, which can be seen in Building 200 (fig. 8.32 and 8.33).

Fig. 8.32. Basins situated between the pillars in Building 200 (B1:30).

Building 200 is a tripartite-pillared building. After excavation the basins collapsed; here (fig. 8.34) one of the basins is still visible between the pillars in the foreground, and a broken basin is visible between the two rows of pillars. The basins might have been used with water because the surroundings were carefully plastered. It is possible that some activity associated with textiles was performed here. The presence of the cistern C135 (fig. 8.22) close to building 200 and the fact that within building 200 different minerals such as pieces of hematite and ochre and a palette[103] with copper residue (fig. 8.46) have been found, might suggest that minerals were crushed to be used in some kind of dying process in and around this building. This could have been one of the usual techniques of dying cloth or yarn in some kind of liquid, but because of the different minerals found perhaps also a different kind of process to make coloured cloth could have been performed here. Painting with minerals (and clay) on cloth creates a mud cloth, that is, a cloth coloured with mineral pigments using clay as a device. Painted mud cloths are known from different parts of Africa.

Basins not incorporated in the architecture
At Khirbet al-Mudayna, basins not belonging to architectural constructions have been found in several places. Most of the basins were made of limestone, are rectangular in shape, about 20-30 cm high, or circular and shallow. They were found within the pillared buildings 200, 205 and 210. It is possible that the basins were used for fulling wool (Mazow 2010 and personal communication). However, the smell of fulling and dying textiles with liquids would have been very pungent (and unhealthy) within a building.
The most spectacular basin was found in the gate area in room R103 (fig. 8.27). It is a large limestone basin (MT160) (fig. 8.34) found in 1996 together with charred wooden beams and ceiling material both above and below the basin, indicating that it fell from the first floor (Daviau 2000:260). The basin is 1.60 m long and 0.70 m wide. Three engraved pictures can be seen on it. The pictures were scratched into the limestone and show a palm tree (fig. 8.39) an animal with a pattern resembling a loom construction (ground loom) or a woven border (fig. 8.38), and two scratched forms that could be interrelated as a stylized loom (fig. 8.35-8.37).

[103] A similar alabaster palette without copper residue has been found at Deir Alla. (no. 13793 on display in the Museum of Deir Alla Station for Archaeology in Deir Alla).


Fig. 8.33. Tripartite pillared building 200.

The illustrated basin from the gate area is the only basin with such illustrations known from the Levant. The motif of the palm tree and the stylized animal seem to fit with the pictorial symbols known from the Levant. Palm trees symbolize sacred trees and such stylized horned animals are interpreted as ibexes (Dothan 1982:152; Keel and Uehlinger1998:39-40; Yasur Landau 2008:224).
The 'looms' are drawn very primitively and can perhaps be interpreted as a schematic representation of looms. The motifs shown in figures 8.35 and 8.36 look a bit like a warp-weighted loom, while the motif below the animal (figs. 8.37 and 8.38) seems to show a kind of woven band or a horizontal loom seen from above. Such decorations have never been seen before and are not comparable to other illustrations from the Levant. The scratching technique is comparable to the way in which the texts and figures from the tombs of Khirbet Beit Lei were made (Zevit 2001:fig. 5.11;5.12;5.15-5.18; 5.21-5.32).

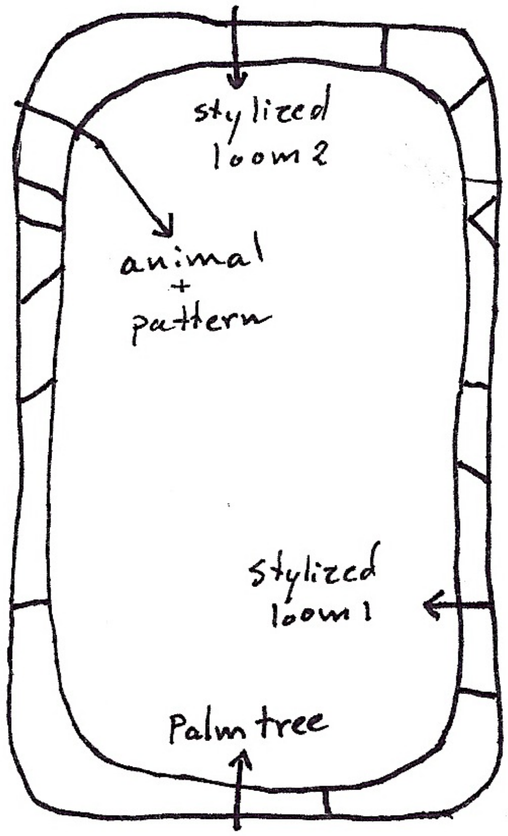


Fig. 8.34. Basin MT160, rim reconstruction, showing the position of the drawings (after field drawing).

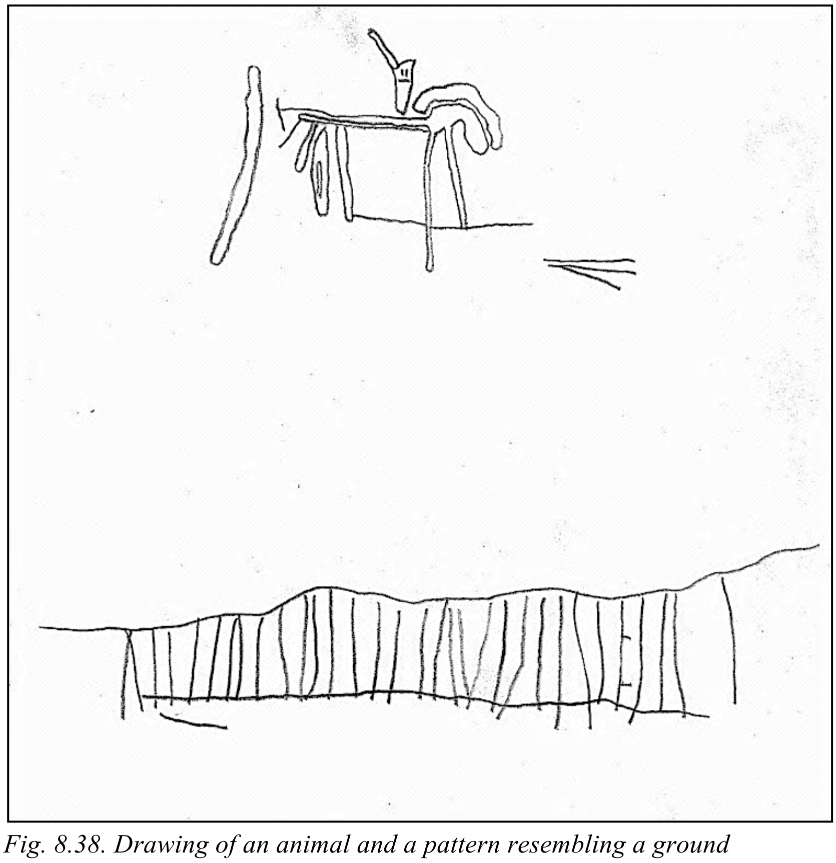


Fig. 8.38. Drawing of an animal and a pattern resembling a ground loom or a woven border on basin MT160.

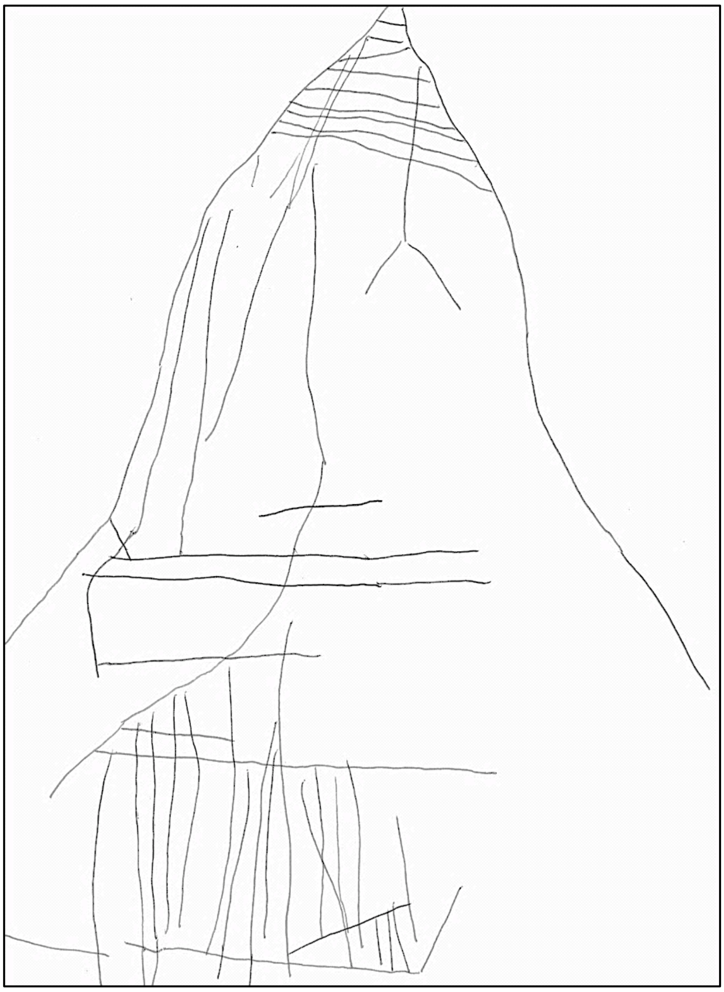


Fig. 8.35. Drawing of 'stylized loom 1' on basin MT160.

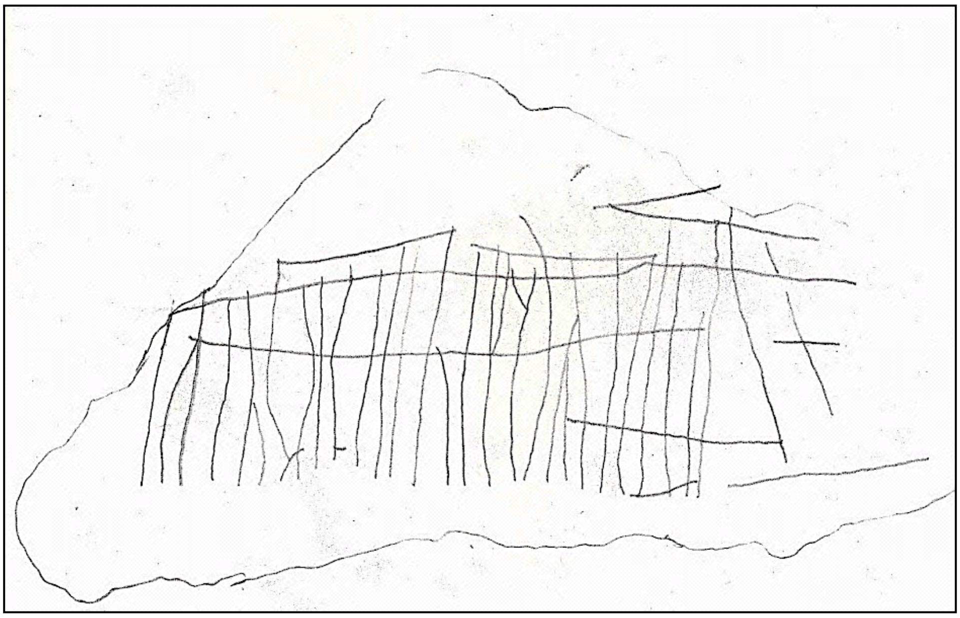


Fig. 8.36. Drawing of 'stylized loom 2' on basin MT160.

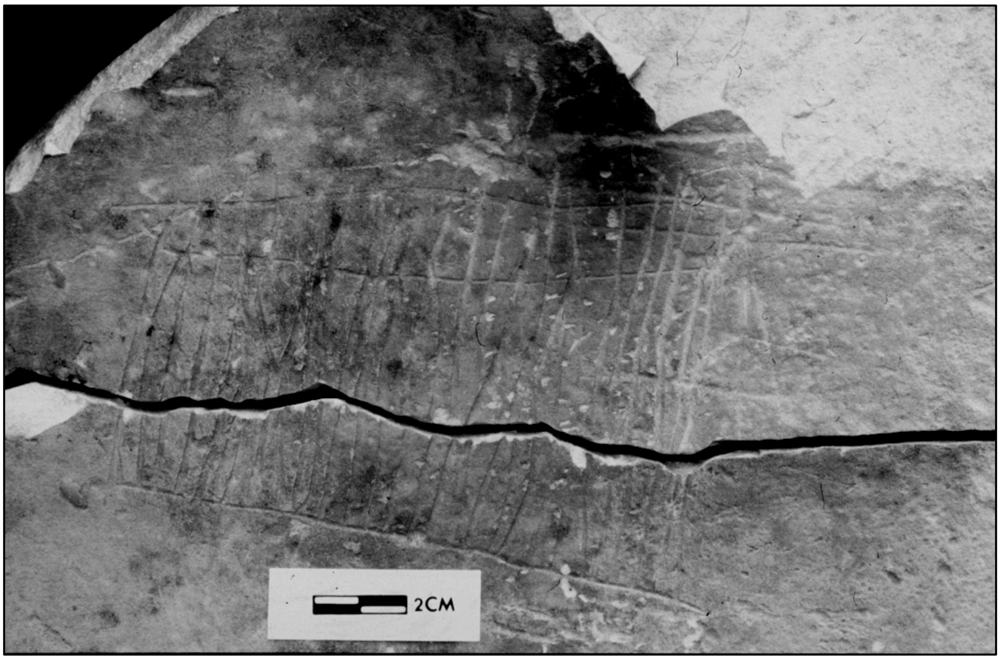


Fig. 8.37. Picture of 'stylized loom' on basin MT160.

Fig. 8.39. Palm tree on basin MT 160.

c) Cache of astragali

Astragali are the knucklebones of animals. A cache of sheep and goat astragali has been found in the northeastern part of pillared building 200, in room 201. The astragali (number not mentioned) were found together with loom weights, a grinder and textile fragments (Weigl 2006). One single astragalus was found in room 221, where the loom weights of Group 5 were found.

Astragali might have been used in the weaving process as shuttles to hold the yarn. As astragali and loom weights have been found together, both in and out of religious contexts, further study of this phenomenon is needed.

A cultic or ritual function has often been suggested for astragali. In Tell Ta'anach, 140 astragali were found in the cultic structure, together with 58 loom weights, as well as 80 ceramic vessels, several grinding stones, spindle whorls, beads, iron and bronze implements, three small steles and a figurine mould (Lapp 1964:26-32,35-39). The largest sample of astragali from Iron Age context comes from Megiddo Stratum VA-IVB. Here, 684 astragali were collected together in a deep bowl, found in situ in building 2081, which is located near the northern city gate. Loud suggested a ritual function for the room (Loud 1948:44-46, 161-162, fig. 100-102, plate 285, figure 388). In Lachish III a smoothed astragalus was found inside a favissa (Aharoni 1975:87 plate 30:3-3A), while in the sanctuary of Tel Qasile twenty astragali were found scattered in different rooms (Mazar 1985:150 table 2). At Tell es-Safi two extremely large assemblages of loom weights have been found in different cultic contexts (personal communication Debi Cassuto 2013).

Finds of astragali have also been made in contexts not associated with a cult. At Tell al-Hammah an unspecified large number of astragali was collected from the western complex of Terrace L (Room 406) (Cahill and Tarler 1993:562). Tell Jawa yielded one astragalus (Daviau 2002:164), which was considered to be a gaming piece. From Tell Deir Alla, one large knucklebone (4.0 cm long) has been published (Franken 1992: fig. 4-25:39), while from Tel Miqne-Ekron about forty worked sheep astragali were found in private and utilitarian contexts (Gilmour 1997:168, fig. 1). From Tell Mardikh-Ebla, 202 worked and unworked astragali were found in several contexts from Early Bronze to Iron Age layers (Minniti and Peyronel 2005:7-26).

8.7 Indirect evidence of textiles

Two impressions of textile on the surface of a clay jar stopper have been found at Khirbet al-Mudayna, as well as a carbonized impression of a piece of cloth wrapped around an unknown substance.

a) Jar Stoppers with cloth impressions

MT1085 A10:12 is situated to the north of the gate area (fig. 827). There is no information available about the circumstances in which it was found. This is the upper part of a clay jar stopper with visible cloth impressions (Fig. 8.40). Its diameter is 6.9 cm and the height is 4.0 cm. The stopper was fired and extremely brittle. The stopper is made of the same local light yellow clay as used for the loom weights. The temper contains organic material in different sizes (ranging from 2-5 mm), and the impressions of the plant material are clearly visible. Sand and stones were also used as temper: limestone varying in size from 1.4 to 2 cm, and pieces of chert varying from 0.3 to 2 cm. The use of such extremely large pieces of stone made the stopper very brittle. The poor condition of the stopper, together with the extremely coarse temper, complicates analysis of the impression. The cloth that once covered the stopper was a loose gauze-like weave; the threads measured 0.5 mm in diameter and were woven in a single tabby weave. The thread count is eight threads per cm in the weft and ten threads per cm in the weave. Neither the fibre type nor the twist could be ascertained.

Fig. 8.40. Jar stopper MT1085 with cloth impressions.

b) Jar stopper MT2490
From Room 211 in pillared building 205 (B22:29), (fig. 8.25) it was found together with some spatulas and close to the loom weights of group 3. This jar stopper showed a faint cloth impression (fig. 8.41). The jar stopper is complete, with a smoothed lower part. The measurements are: upper part diameter: 5.9 cm, the diameter of the rim: 4.9 cm, and the height of the stopper: 4.8 cm. The stopper was made of local selected fine yellow clay. The temper contains organic material varying in size from 1-4 mm in length and small pieces of limestone varying in length from 2-7 mm; a piece of shell measuring 3 mm in diameter is visible on top of the stopper. The cloth impression is only visible on a very small part of the rim of the jar stopper (0.7x1 cm) and also very faintly on the side of the upper part of the object. The cloth was a loose weave, suggesting a plain tabby weave. The weft and the warp threads measured about 1 mm in diameter. The twist of the yarn was not visible, nor could the fibre type be determined.

Similar jar stoppers with cloth impressions have been found at various sites in the Levant. At Beth Shean in Stratum IV, a cloth impression has been found from an early Iron Age level (Yadin and Geva 1986:82-83, plates 82-84). At Tel Gezer, Macalister refers to a jar handle with a cloth impression (Macalister 1912:II:76). From Tell es-Saidiyeh, Stratum V 32-E-8, house 16, an impression of woven cloth on clay is mentioned (Pritchard 1985:fig. 170:2). Unfortunately, few details have so far been published about any of the above finds. In the Iron Age levels of Tell Deir Alla, a jar stopper (DA 2770/1982) with a textile impression has been found, but neither the nature of the cloth nor the thread count are clearly visible. Nevertheless, it is possible to see that the individual threads were Z-spun and that the weave is a simple tabby weave. Because the cloth is a reverse impression, the spin appears to be S-form (G. Vogelsang-Eastwood, Deir Alla textiles, unpublished paper). The recently published textile impression from the Early Bronze Age levels of Tell Abu al-Kharaz is a plain tabby weave; the thread count is 19-25x13 threads per cm, and the impressions of the yarn are 0.2-0.4 cm in diameter. The spinning direction was Z in both yarn systems since the impressions are in the S-direction. Nothing can be said about the material (Fischer 2008:399 and fig. 318).

Fig. 8.41. Jar stopper MT2490 with faint cloth impression.

c) Cloth-wrapped substance MT 937

Found to the north of the gate area C93:9 (fig. 8.27), it was found together with a donut-shaped loom weight. There is no information available about the circumstances in which the artefacts were found. The item is registered as the lower part of a burnt jar stopper, but after analysis it turned out to be a burnt, cloth-wrapped substance (fig. 8.42 and 8.43) The cuneiform item once contained a kneadable substance wrapped in a fine gauze-like piece of cloth, probably for keeping it in storage. The fabric covered the matter on all sides, and the wrapped substance was placed in a small vessel or pot. As a result the imprint of the textile is clearly visible on part of the material. In the destruction fire of the site the cloth itself burned away, but the impressions of the weft are still visible on the object. The small bundle covered with textile measures 4.2 cm in diameter and is 3.4 cm high. The fine and pliable cloth is made of a thin thread, 0.25 mm in diameter, woven in a single tabby weave. The thread count is 14x18 threads per cm (14 threads in the warp and 18 threads in the weft). Neither the twist nor the fibre type could be determined from the impression. A small part of the wedged selvedge was visible. The material wrapped in the cloth contained an organic matter attractive to insects, whose larva in the organic material came out after some time and left traces in the perhaps still partly moist material covered by the cloth.

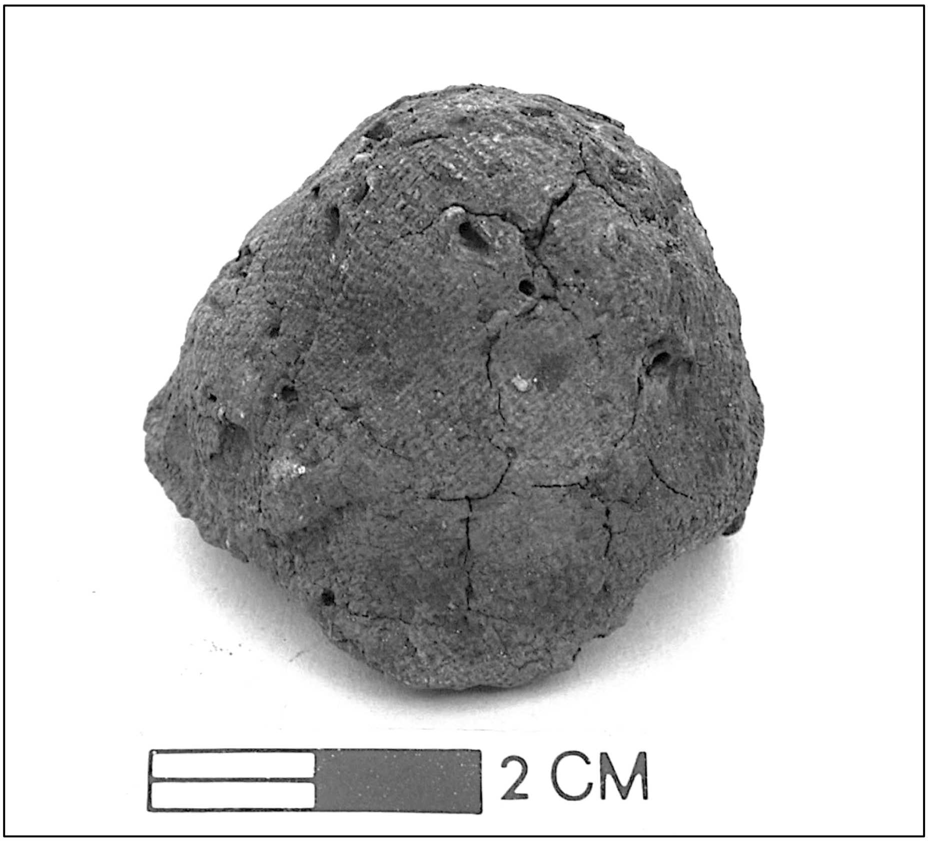


Fig. 8.42. Cloth-wrapped substance MT937 (base).

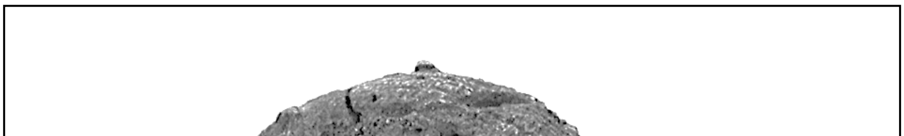


Fig. 8.43. Cloth-wrapped substance MT 937 (side view).

8.8 Distribution of the finds

The plotting of the textile production-related finds over the squares and loci shows some interesting clustering (see fig. 8.19.a). Five groups of loom weights representing a more or less complete loom have been found in different parts of the excavated area.

Loom 1 consisting of 55 loom weights was found in Building 145, Room 131 (A30:67). The loom weights were found together with the carbonized wood of the loom (fig. 8.45). Here the basket interwoven with linen threads (MT1700-1703) was also found; the loom weights were found together with a conical spindle whorl made of an unknown material (MT2592). In this room a miniature altar, a lamp and several polishing and grinding implements were found as well.

Loom 2 consisting of 22 loom weights was found in pillared Building 200, in the eastern part of Room 206 (B11:52 and B11:53). The loom was found together with five spindle whorls and one spatula. In this building large amounts of pottery and animal bones as well as several pounders and grinding implements have been found. A special find from this room was an alabaster palette (MT1088) measuring 9.73x8.77x2.28 cm and showing traces of greenish colour, which could be a residue of copper (fig. 8.44). The palette could have been used to mix pounded minerals with some kind of liquid to produce a kind of paint or dye. The typical green colour suggests copper oxide. Further analyses are needed to confirm this idea. My suggestion that it is possible that some kind of mud cloth was produced at Mudayna was initiated by the find of the different minerals in combination with this palette.

Loom 3 was found in the western part of the same Room 206 (B1:38 and B1:39). The loom consisted of 17 loom weights. The ceramic cup covered with a woven textile (MT1265) and the jar stopper with cloth impression MT1085 were found in Room 203 on the west side of this building.

Loom 4 consisting of 39 loom weights was found in pillared Building 205, Room 211, together with a limestone spindle whorl (MT1148) and a spindle whorl made of a reworked sherd (MT1309). A miniature altar (MT1173), a shallow limestone basin (MT1207), three grinding stones MT1175, 1149, 1250), a bronze hook (MT890) and a door socket (MT1253) were also found in this room.

Fig. 8.44. Palette with green residue (MT1088).

Loom 5 consisting of 22 loom weights was found in pillared Building 210, in the western part of Room 221. The loom weights were found together with some burnt wooden beams, apparently the remnants of the loom itself.

Fig. 8.45. Room 131 showing the loom weights with charcoal remains.

In the gate area, loom weights were found from different areas and loci. Rooms 101,102 and 103 are situated in the eastern part of the gate area (fig. 8.27). The illustrated limestone basin (MT160) was found in the gate area in Room 103, that is, the southeastern gate chamber. Rooms 151, 152 and 153 are situated in the western part of the gate area (fig. 8.27). It is not clear to me where these loci are situated within the different rooms. In the gate area, one more large limestone basins was found; it also fell from the upper storey into gate room 151. This basin was associated with a group of unfired clay loom weights (Daviau 2000:285). Room 153 yielded no loom weights, and no spindle whorls or objects that might have been used in textile production. Outside the rooms to the south in area C97 a spatula (MT577) was found in C97: 4; no other finds have been registered from this locus. To the north in area C94, three spindle whorls were found together with a sling stone (MT764). Further to the north in C93 one loom weight was found together with a polishing stone (MT1146) and a ceramic strainer (MT1012).
The excavator suggested that the tools were kept in storage in the gate chambers, but from the artefact lists and the field reports it cannot be concluded that the different tools cluster, therefore it is not possible to tell why a number of objects associated with textile production were found in some of the gate chambers.

8.9 Conclusions

The artefacts associated with textile production and the architecture of Khirbet al-Mudayna open up a window on production estimation of yarn and cloth, answering the question whether the site could have been a centre of intensive textile production as suggested by the excavator.

Loom weights and production estimation
The weight of the loom weights suggests that the yarn used on the looms was wool. As there is no evidence for the spinning of fine wool at the site, the yarn was probably bought as spun yarn from outside the settlement. Five looms could be estimated at Khirbet al-Mudayna (155 loom weights);

the remaining 95 loom weights were scattered over the settlement. The 250 loom weights from Khirbet al-Mudayna are not very heavy, their average weight is 269 g, suggesting that a light and fine textile was made which could have been of wool. When taking the five groups of loom weights as each representing a more or less complete loom, the outcome is as follows:
Group 1 average weight 248 g
Group 2 average weight 266 g
Group 3 average weight 391 g
Group 4 average weight 197 g
Group 5 average weight unknown

According to the weights, groups 1, 2, and 4 were looms used to make a light and fine textile; they were possibly used to produce woollen cloth. Group 3 is slightly different because the loom weights are heavier, the average weight is 391 g, and because there is one extremely heavy loom weight (2400 g). The average number of weights within a large group is 31 loom weights, with an average total weight of 7115 g.

By applying some general figures to the material of Khirbet al-Mudayna, it is possible to indicate the amount of textiles produced at the site. At Mudayna 250 loom weights were found; usually a loom consisted of about 30 loom weights, the loom weights from Mudayna represent 8.3 looms. According to Anderson Strand (2010:12), a maximum of 1.25 kg (ewe) or 2.5 kg (whether) from a fleece can be used for spinning. From Neo-Babylonian texts it can be deduced that an individual weaver at home could produce 2.5 kg of wool fabric in 6 months (Joannès 2010:404). Applying the amount of wool fabric as recorded in the Neo-Babylonian texts to the situation in Khirbet al-Mudayna, the outcome is as follows: if eight looms were in use for weaving, 20 kg of woollen cloth could be produced in six months. If the weaving is performed all year round, 40 kg of woollen cloth could be produced in a year at Khirbet al-Mudayna. To produce 40 kg of woollen textile, the wool of about 75 sheep was needed.

Yarn produced at Mudayna
The weight of a spindle whorl can indicate the quality and sometimes also the type of fibre being spun, as demonstrated by experimental studies (Ryder 1968:82-81; Barber 1991:52; Andersson 2003). Lighter whorls were most probably used for wool, while the heavier whorls could have been used for plying wool or spinning vegetal fibres together (Burke 2010:114-115). Fine wool needs a spindle of about 8 g, while medium to heavy wool requires a slightly heavier whorl of up to about 33 g (Barber 1991:52). The 33 excavated whorls from Khirbet al-Mudayna are extremely heavy (average weight 80.5 g ranging from 40 -190 g) pointing to the production of thick woollen threads or possibly linen or hemp yarn.
From the shape of the spindle whorls, a rough estimation can be made of whether vegetal or woollen yarn was produced. It has been suggested (Garstang 1953:172-173) that the flat spindles were used for spinning wool, while the bulbous spindles were used to spin vegetal materials such as flax and hemp. Assuming that the ceramic and reworked sherds are flat, while ivory, bone and stone spindles tend to be bulbous, the following reconstruction can be made: twenty-two (67%) spindle whorls are bulbous and probably were used to spin vegetal material. Only 11 spindle whorls (33%) are flat and may have been used to spin wool. These flat whorls are heavy and thus produced a thick wool thread, possibly to be used as warp on the loom or to produce coarse woollen fabric. However, none of the spindle whorls at Khirbet al-Mudayna is lighter than 40 grams, fine wool or linen could not be spun with the spindle whorls found within the settlement.

Was Khirbet al-Mudayna a centre for textile production?
All the spinning and weaving implements were found in public areas, and the excavator thus suggested that the textile production took place mainly within the pillared buildings or on the roof of these buildings. But in the area excavated only five looms could be estimated and a mere 33 spindle whorls have been found. This suggests that the people who were occupied in activities at Mudayna covered part of their textile needs by spinning and weaving. It is also possible that a

very limited amount of special textiles was produced at Mudayna to be used at the site or to be sold or traded. This picture fits the description and conclusions of Popkin (2001).
Can Khirbet al-Mudayna be regarded as a centre of textile production, or specialized in textile production, as suggested by the excavator M.P. Daviau when she wrote: 'Long famous for its sheep and wool (Kgs.3:4-5), the rolling hills of Moab were a natural setting for a production centre for weaving woollen textiles.' (Daviau 2006:23). And in 2007, Daviau and Chadwick (2007:311-312.) point to the fortress site of al-Mudaybi where 65 loom weights were found in one room (Wade and Mattingly 2002) and then state *"…clearly these finds are evidence for extensive textile production. This industrial specialization may have been designed to supply textiles to the court, or to an even larger market, such as that provided by the Assyrian empire. "*
The finds prove that these ideas can be regarded as a form of speculative enthusiasm. Khirbet al-Mudayna was not built as a textile-producing city, it did not function as a specialized urban economy, nor did it function as a supply centre for other sites in the region. The quantity of textiles produced at Mudayna was very low. Even if all of the 250 loom weights found at Mudayna belonged to a single loom, only 8 warp-weighted looms could have been operated at the site. It has to be noted that 33 spindle whorls and 250 loom weights is not enough to speak of some kind of industry.

The presence of many shallow limestone basins and the plastered constructions with basins between the pillars inside two of the pillared buildings at Khirbet al-Mudayna does suggest that textiles were dyed or fulled there. or, more likely, that yarn was dyed there, but this idea needs future research.
The herders and farmers working around Mudayna did not live in Mudayna (Popkin 2001). Mudayna served as a military outpost, protecting the local roadways. It could have functioned both as a local market and a regional administrative centre with a sanctuary for both the local population and traders passing by the site (Popkin 2001). Because the weaving and spinning implements have been found in public areas and not in domestic contexts, the product was possibly meant for public use or profit.
For further interpretation of the architecture and the finds see Chapter 12.1 – 12.2.

Fig 8.48. Loom weights from Khirbet al-Mudayna under study.

Chapter 9 Study of the Excavated Remains: Tell er-Rumeith

9.1 Introduction

Tell er-Rumeith (map reference 247/212) is located in northern Transjordan, east of Irbid and near the modern town of Ramtha, not far from the Syrian border (map 1.1). Situated in the eastern part of northern Gilead, Tell er-Rumeith is located in a plain in the hill country. The main mound is a rocky outcrop, about 50 m in diameter, rising approximately 10 m above the surrounding plain. Paul W. Lapp excavated a quarter of the tell in 1962 and 1967. The northeastern quadrant of the tell was excavated down to bedrock, and part of the southeastern quadrant along the eastern fort wall was also excavated (Lapp,P.W.1963; 1968; 1969;1975; Lapp, N.1989;1993; Barako 2008;2009).[104]

Strata and dating

Rumeith was a small rectangular fort measuring roughly 37 by 32 m, surrounded by a moat and protected by a glacis. The outer rampart is about 30-40 m wide at its base. According to Finkelstein, Lipschits and Sergi (2013:15), its closest parallel is Khirbet al-Mudayna ath-Thamad in Moab (see Chapter 8). The excavations concentrated on the Iron Age strata of the mound proper. The mound's main stratigraphy represented an occupation of about two centuries of Iron Age strata.

Stratum VIII. The fort was symmetrical in plan (fig. 9.1). The northern wall was 1.25 m thick with a recessed gateway, approximately in the middle. The eastern wall was 1.50 m wide. There was a gateway in this wall, but it was obliterated by Stratum VII. A room measuring 3.25 by 2.25 m was excavated in the interior of the fort in the northeastern corner. The remains inside the fort indicate that the occupants grew grain. The ceramic assemblage dates Stratum VIII to the second half of the 10th century BC, Iron Age IIA (Lapp 1975:114,115; Barako 2009:10).

Stratum VII. After the destruction, the occupants of Stratum VII surrounded the mudbrick fort with a stone defence line composed of very large boulders (fig. 9.1). The earlier gateways were reused and casemates were constructed to the north and east side of the fortification. The eastern entrance, only one meter wide, was protected by a guardroom (fig. 9.1). Lapp characterized the pottery as 'Syrian', and the destruction of Stratum VII is dated to the mid-9th century BC, Iron Age IIA (Lapp 1975:114,116; Lapp 1993:1292; Barako 2008).

Stratum VI. A thick layer of grey clay was laid over the entire area to create a platform in between the walls of the fort of Stratum VII, indicating an overall building plan. (Stratum VI is not on the plan in fig. 9.1). In the southeastern part the stratum was well preserved: walkways in between houses were set out in a rectangular grid all with the same width and composition, and the houses were alike in character and plan; each unit consisted of two rooms, one with a cobbled floor and the other containing the foundations for a stairway to the roof (Lapp 1975:117; 1993:1292). This stratum was dated to c. 800 BC, Iron Age IIB (Barako 2009:11).

Stratum V. A final short phase of Stratum V followed the main occupation of houses with mudbrick floors in Stratum VI. A copper-refining kiln and a lot of pottery was found above and inside the northern Stratum VII defence line (Lapp 1975:118; 1993:1292; Barako 2008). This stratum is not indicated on fig. 9.1. Lapp and Barako dated the destruction to the campaign of Tiglath Pileser III in 733 BC (Lapp1975:113; 1993:1293; Barako 2009:11; Finkelstein, Lipschits and Sergi 2013:20).

A small collection of objects associated with textile production has been recorded from the fort. Tristan J. Barako will publish the definitive dating and stratigraphical information in the final report (Barako and Lapp forthcoming 2013). The textile-related materials consist of 18 spindle whorls, 99 loom weights, 18 spatulas and 2 shuttles. These artefacts were found in different strata

[104] For a discussion of the historical geography and biblical texts see Barako 2009:5-6.

and loci, all dating to the Iron Age. I have seen the artefacts in storage, but I could not study them myself. I have used the data in the artefact lists and the drawings kindly supplied by Nancy Lapp.

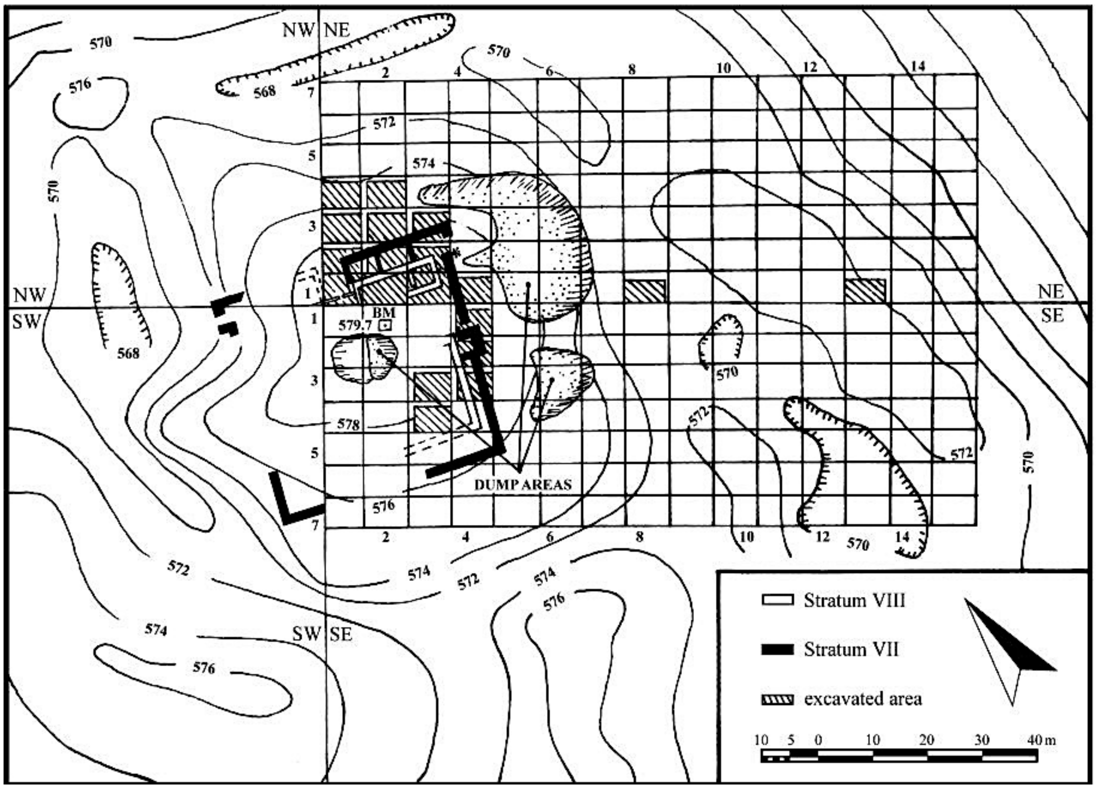


Fig. 9.1. Plan of Tell er-Rumeith Strata VIII and VII (Barako 2009: 8, fig. 2).

9.2 Spindle whorls

A total of eighteen spindle whorls has been recorded at Tell er-Rumeith. They are made of stone and ceramics and their weights vary from 1.5 g to almost 100 g. The weight of the spindle whorls was studied in order to discover what kind of raw materials were used to produce yarn. Twelve spindle whorls were made of stone; most of these were dome-shaped (fig. 9.4); the other six are of fired clay, they are discoid and made of reworked potsherds (fig. 9.5).[105]

Four spindle whorls have not been finished; no. 14 is a heavy stone (crystal) whorl with the hole only partially drilled (fig. 9.2) and thus the weight is not precise. Discs 304 and 62-54 are made of reworked potsherds and are only partially pierced. Disc 309 is not perforated; it is a circular ceramic disc whose weight and diameter fit perfectly in the range of the other spindle whorls. Perhaps it had still to be pierced. The unfinished spindle whorls, both ceramic and stone, show that they were made in the fortress area.

Stone whorls

The stone whorls are made of various kinds of stone. They are relatively small and tall, and their weights range between 1.5 and 99.7 g. The average weight of a stone whorl is 23 g, the preferred weight is between 10 and 25 g. The heaviest whorl is 99.7 g. The diameters of the stone whorls range between 1.5 and 5.5 cm and the average diameter is 3 cm (Table 9.1, fig. 9.3). The height (thickness) of these whorls ranges between 0.9 and 4.4 cm, and the average height is 1.8 cm. One

[105] A general introduction to spindle whorls is given in Chapter 2.2. See also the spindle whorls from Khirbet al-Mudayna in Chapter 8.5.

whorl (no. 308) is extremely light and small (1.5 g and 0.9 cm in diameter); it may be a bead and not a whorl, though the tapering shape of the object suggests it is a whorl (fig. 9.2 right). Five spindle whorls are dome-shaped. No. 14 is a dome-shaped rather heavy stone whorl that is only partially perforated (fig. 9.2 left). No.135 is made of chalk.

Fig. 9.2. Spindle whorl nos. 14 (left) and 308 (right).

Reg. no.	Weight in grams	Diameter in cm	Height in cm	Remarks
13	99.7	5.0	2.0	
24	53.4	5.5	unknown	limestone
21	29.9	3.5	2.0	
135	28.2	4.8	unknown	chalk
23	20.6	3.3	1.5	
31	19.0	3.6	Unknown	
27	10.8	2.5	1.5	
25	9.8	2.4	1.4	bituminous
301	9.3	2.5	1.0	
308	1.5	1.5	0.9	
14	± 47.8	3.1	4.4	Partially perforated

Table 9.1. Stone spindle whorls (N=12).

Fig. 9.3. Stone spindle whorls nos. 21, 23, 25, 27.

Ceramic whorls
The ceramic whorls are discoid, and their weights range between 21 and 51 g, with of the majority 37 to 40 g (Table 9.2, and figs. 9.7-9.8). The widths range between 6.1 and 4.2 cm and the average diameter is 5 cm. All these whorls are thin, about 0.8 cm. The ceramic whorls are made of reworked sherds and are thin, wide and relatively heavy. Table 9.2 shows that the weight of the ceramic discs is between 21 and 51.5 g, and their weights are more uniform than the weights of the stone whorls. All the ceramic whorls belong to the middle category of light spindle whorls.

Reg. No.	Weight in grams	Diameter in cm	Height in cm	Remarks
303	37.7	6.1	0.7	
302	21.0	4.2	0.8	
305	10.9 (half) ± 21.8	4.5	unknown	
54	± 51.5	5.6	unknown	partially perforated
304	± 40.8	5.0	0.8	partially perforated
309	± 34.9	4.3	unknown	not perforated

Table 9.2. Ceramic spindle whorls (N=6)

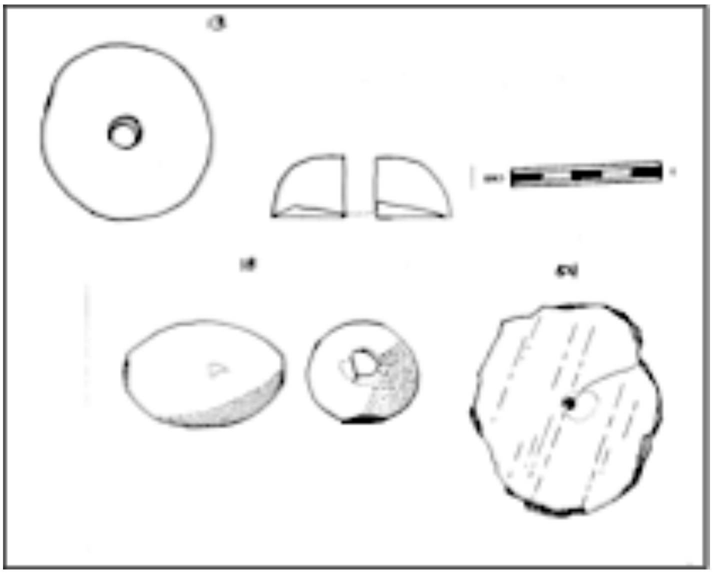


Fig. 9.4. Spindle whorls nos. 13, 18 and 54.

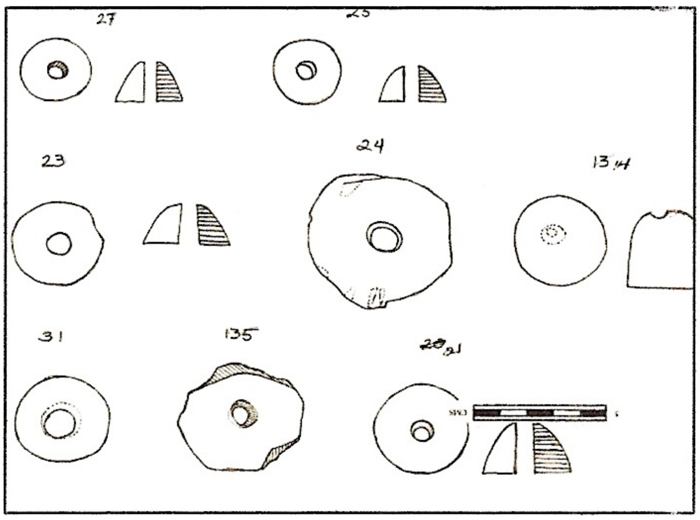


Fig. 9.5. Spindle whorls nos. 1, 14, 23,24, 25, 27, 31 and 135.

The 18 spindle whorls of Tell er-Rumeith show essential differences in shape and weight (figs. 9.4-9.6). All the spindle whorls of Tell er-Rumeith can be regarded as light whorls, weighing under 100 g. The upper weight limit of a spindle whorl is about 140-150 g. (Barber 1991:52). Light spindle whorls tend to weigh about 25-33 g (Burke 2010:114-116), and medium whorls 34-100 g – eight whorls from Rumeith belong to this category. Heavy whorls range in weight from 100 to 150 g; no such whorls have been found in Rumeith. Therefore a different categorization had to be made.
According to Burke (2010:114-115), 10 g can make a difference when spinning. Because we only have 18 whorls all weighing under 100 g, only three meaningful groups could be distinguished (fig. 9.9). The 12 stone whorls can be divided into two groups: 5 very light whorls weighing 1.5-9 g and 6 medium-light whorls weighing 20.6-53.4 g, with one extra heavy whorl weighing 99.7 g. The 6 ceramic whorls weigh between 21 and 51.5 g and all of them thus fall in the medium-light category weighing between 20 and 55 g.
Ten of the spindle whorls from Rumeith weigh less than 33 g, two of which are made of ceramic and eight of stone.

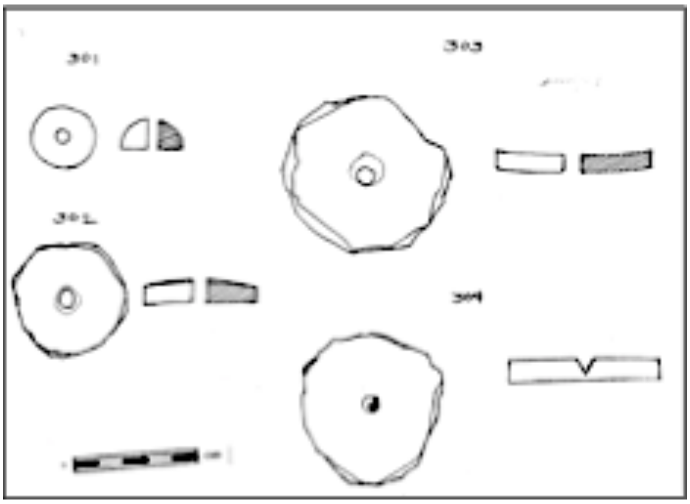


Fig. 9.6. Spindle whorls nos. 301-304.

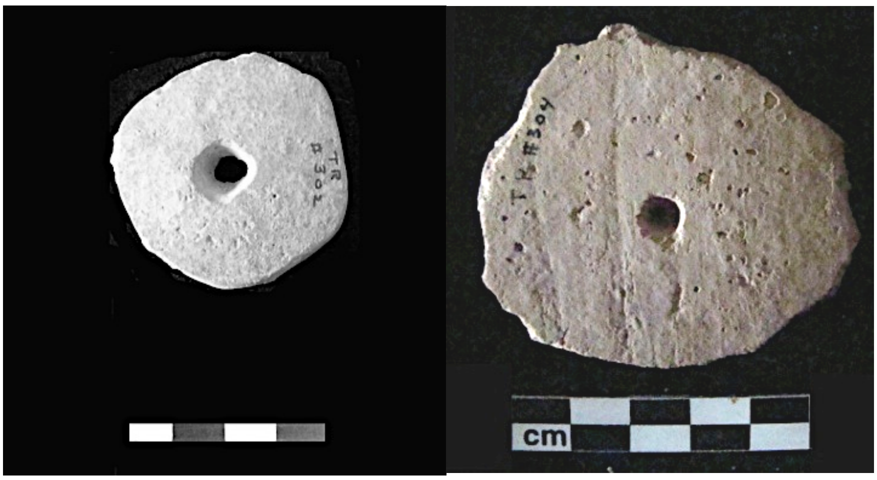


Fig. 9.7. Ceramic spindle whorls nos. 302, 304.

Fig. 9.8. Ceramic whorls nos. 303 and 135.

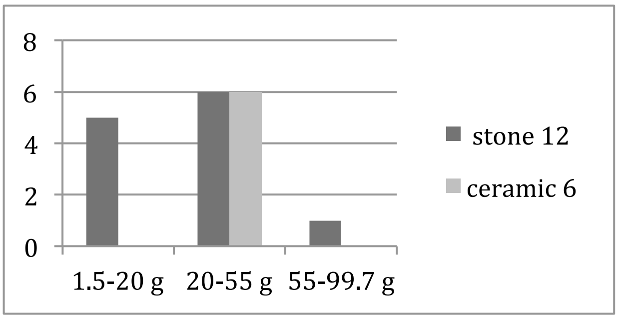


Fig. 9.9. Spindle whorls (horizontal weight / vertical number of whorls N=18.

Conclusion

The spindle whorls of Tell er-Rumeith show essential differences in shape. The ceramic whorls are made of reworked sherds; they are thin, wide and relatively heavy. From the graph above it can be seen that the weight of the ceramic discs averages about 40 g. Their weight is more stable than the weight of the stone whorls. The stone whorls are made of various kinds of stone. They are lighter in weight, relatively small and tall, without any decoration. Small and light whorls suggest that wool was spun and not flax or hemp. The stone whorls were used to produce a fine woollen thread. The ceramic whorls, heavier and wider than the stone whorls, were used to make a coarser medium woollen yarn, or they could also have been used to ply two fine woollen threads together.

9.3 The loom weights

The number of loom weights recovered at Tell er-Rumeith was comparatively low. A total of ninety-nine loom weights were recorded, the majority (97) being donut-shaped and made of unfired clay. A loom requires a set of at least 10 loom weights (Boertien 2004:313). Usually the recorded area and locus can be used as parameters to reconstruct to which loom the weights belonged. Though most of the recorded loom weights excavated at Tell er-Rumeith are from different loci and strata, and few of them cluster thus representing a loom, they can be studied as a group. Because the excavated area was small they reveal some general information about what kind of textile was produced. Taking into account that many loom weights have been lost, it can be estimated that at least five warp-weighted looms were once present in the Tell er-Rumeith areas excavated.

Unfired donut-shaped clay loom weights

Ninety-seven unfired clay loom weights were found in the Iron Age fortress area at Tell er-Rumeith. Compared to other sites this is relatively few (Chapters 6, 7 and 8; Sheffer 1981; Browning 1988; Friend 1998; Boertien 2004; Boertien 2012), but in addition to the environmental features, this may be because of the limited area excavated. There were no large clusters or rows of weights mentioned in the field reports.

The weight of the loom weights ranges between 69 and 706 g and the average weight is 243 g. The weight of Iron Age loom weights from the Jordan Valley ranges between 466 g at Tell Deir Alla (Chapter 6; Boertien 2004:322) and 471 g at Tell Mazar Stratum V and III (Chapter 7; Boertien 2012:63-67). The loom weights of Tell er-Rumeith are comparable in size and form to those of Tell Khirbet al Mudayna in Moab. The average weight at Mudayna is 248 g (Chapter 8). The loom weights of Tell er-Rumeith are lighter in weight than those from the Jordan Valley, indicating that woollen textile was produced at Tell er-Rumeith. A comparable regional weight pattern in loom weights can be found to the west of the River Jordan, where loom weights from the Shephelah and the hill country are lighter in weight than those from the Jordan Valley.[106] Plant fibres such as hemp and linen were produced in the Valley, while wool was probably produced in the hill country (Shamir 2006:481).

It has to be considered whether a combination of both wool and linen could have been produced at the site. Iron Age textiles seldom survive, but there are two interesting collections from the desert sites of Kadesh Barnea and Kuntillet Ajrud. Fifty textile fragments were recovered and studied at Kadesh Barnea; all are made of linen. Kuntillet Ajrud yielded over a hundred textile fragments; fibre examination showed that most of the textiles were made of linen, eleven were made of wool and only three were made of a combination of linen and wool (Sheffer and Tidhar 1991:1-2, figs. 2 and 16). This special fabric has been described in the Bible as *shaatnetz* (Lev. 19:9 and Deut. 22:1). It is an uncommon textile (Boertien 2007:63-63, 2008), and therefore it can be assumed that such fabrics were not produced at Tell er-Rumeith.

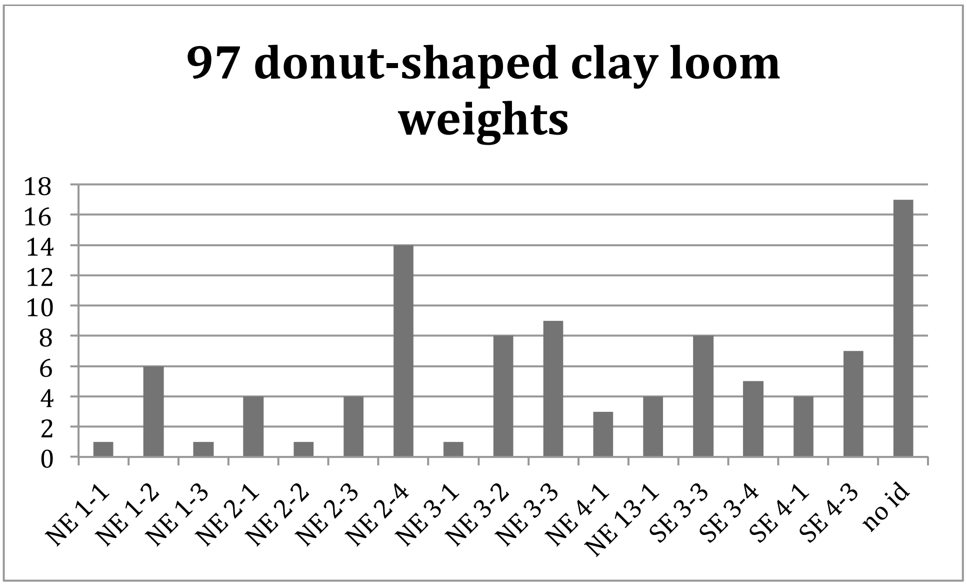


Table 9.4. Donut-shaped loom weights from Tell er- Rumeith (vertical =number, horizontal=square).

[106]The Shephelah has a weight of about 350 g (Tell Miqne, 353.5 g [Shamir 1996:40, table 3], Tell Taanach, Iron Age, 348 g [Friend 1998]). The hill country has a much lighter weight, less than 200 g, and in Jerusalem, City of David, the weight is 160.7 g on average [Shamir 1996:139]). Sheffer and Tidhar (1991:10) suggested that in the Sinai, loom weights of 250 g were used to produce woollen textiles. In the western Jordan Valley the loom weights range between 350-450 g. The Beth Shean region is known from various sources to have been a centre for linen production (Shamir 2006:481).

Other loom weights

The site revealed two pyramidal ceramic loom weights. Loom weight no. 307 is a conical weight with a circular base; the hole is about 1 cm wide. This type is characteristic of the earlier periods of the Iron Age (Friend 1998:72; Boertien 2004). Loom weight no. 306 is a pyramidal weight with a square base; the hole is about 0.5 cm wide. Pyramidal loom weights from Iron Age structures are not common. They have been found at Tell Ta'anach; Friend describes them as poorly fired. The flat top, square base and the small pierced hole (± 0.5 cm) are characteristic of pyramidal loom weights. The weight compares closely to one from Ta'anach (Friend 1998:41-42, fig. 9).

Reg. no.	Weight in grams	Height in cm	Width in cm	Find spot
306	179.1	7	5	NE 3-2 32
307	161.6	7	5.5	NE 2-2 41

Table 9.5. Other loom weights.

Figure 9.13. Pyramidal loom weight 307.

Figure 9.14. Pyramidal square loom weight 306.

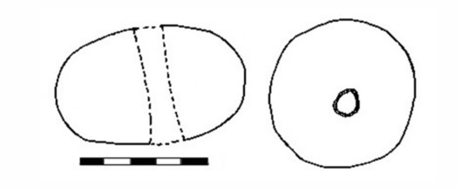
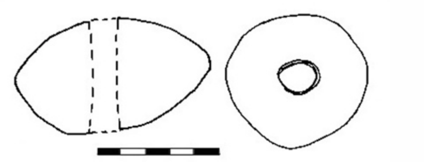
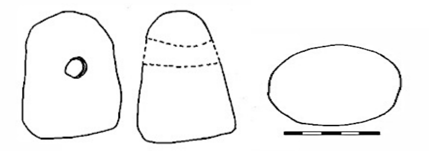
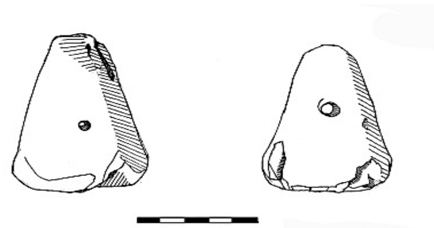
Donut-shaped loom weight  a  b	*Donut-shaped loom weight* *Characteristics:* the weight was made from a coiled piece of clay < 9 cm, the coil was wound around the finger to create the shape. a. *Donut-shaped* loom weight. Characteristics: less than 9 cm in diameter. Width 1 cm wider than height. Perforation diameter 1-2 cm. b. *Bi-conical weight* – a donut-shaped loom weight. The elliptical shape is non-discriminating, the weight was made in the same way as the donut-shaped weight, resulting in identical characteristics: less than 9 cm in diameter. Width 1 cm more than height. Perforation diameter 1-2 cm.
Conical loom weight 	*Conical loom weight* Characteristics: Conical body with a circular or elliptical base. Diameter of the perforation varies from 0.5 to more than 2 cm.
Pyramidal loom weight (square base) 	*Pyramidal loom weight (square base)* Characteristics: pyramidal square body with a square base; measurements differ. Diameter of the perforation diameter varies, usually under 1 cm.

Table 9. 6. Typology of loom weights from Tell er-Rumeith Iron Age IIa - 9th century BC.

Loom weights from the NE quadrant Stratum VII-VIIB (fig. 9.15)

Group 1, the largest group of loom weights was found in roof fall outside the fortress walls (NE 2-4: 6 and 9). The thirteen loom weights are from a loom that stood on the roof of a building. The loom probably fell down together with the roof material.

In *Room X,* in a cluster of rooms situated in the northeastern quadrant of the tell, different caches of loom weights have been found: in the roof fall of the northern part of room X four loom weights and four spatulas have been found (NE 2-3:22). Apparently these loom weights belonged to a loom that was situated on the roof.[107] It is also possible that the four weights and the spatulas were kept in storage on the roof.

Room Z situated to the west of room X was partly paved. Two loom weights have been registered from the paved area (NE 3-3:11 and 13). Two shuttles (316a and 316b) and two loom weight were found in the destruction layers of the small paved room Y (NE 3-3:16), situated directly to the south of room X, and some five loom weights and a spindle whorl have been registered from the deliberate fill (NE 3-3:19).

Room K was situated to the south of the small rooms Y and Z; it is a large rectangular room with a lined pit measuring 2.90-3.20 m in diameter. In the destruction layers of room K (NE 3-2:62 and 63) two loom weights have been found, and some five additional loom weights have been registered in the fill of the lined pit (NE 3-2:54[K24]).

[107] The excavated objects from room X (NE 2-3:22) and the 13 loom weights found outside the fortress (NE 2-4: 6 and 9) show that roofs were indeed used for setting up looms. Several groups of loom weights were found amidst roof debris, and comparable situations have been described for Tel Batash (Browning 1988:133), Jerusalem (Steiner 2001:100), Deir Alla (Boertien 2004:324), Tell Mazar (Boertien 2012:71) and Khirbet al-Mudayna (Chapter 8).

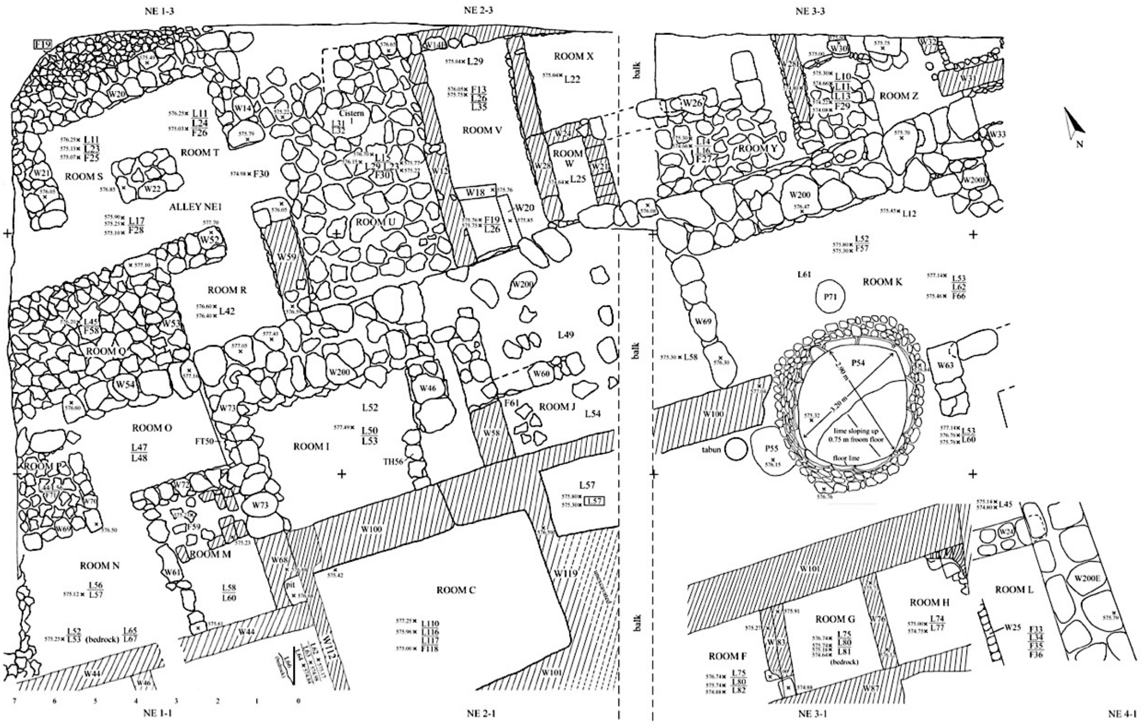


Fig. 9.15. Plan of part of the NE quadrant of Tell er-Rumeith.

To the south of room K there were three small rooms next to each other; rooms (F, G and H) were small and square and similar in shape. A spindle whorl was registered from room H (3-1:77) and another spindle whorl from room G (NE 3-1:81). In a pit in NE 1-2:30 three loom weights and a spindle whorl were found. And spatulas and fragments of spatulas have been registered from three other loci (35, 42 and 37) situated here.

Loom weights from the SE quadrant strata VI and VIB (fig. 9.16)

Three different caches of loom weights have been found in the southeastern quadrant. Groups of loom weights have been found in the destruction layers of different rooms of Building D. A group of six loom weights and a spindle whorl were discovered in room D1 (SE3-3:2 and 4), and another whorl was found in a pit (SE 3-3:19) situated in the southern part of this room. From the wall and roof fall of room D3 two additional loom weights have been registered (SE3-3:18). In building E in the southern most room E1 (SE 3-4:4), three loom weights were found on a paved floor (F29). In building F (SE 4-3:9) a spindle whorl and six loom weights have been found, two loom weights in deliberate fill (SE 4-3:34) and four in locus 23 of fortress wall 100 (Stratum VIII -VII). One loom weight was found in the alley to the south of building F (SE 4-3:21).

The loom weights are probably only some of the original number of weights once used in weaving. The position of the loom weights indicates different looms situated in or on the roofs of buildings D, E and F in the southeastern quadrant of the tell. It can be concluded that weaving was performed at different places in Rumeith. Because the loom weights were scattered about the different rooms it is possible that the majority of the looms stood on the roofs of the buildings.

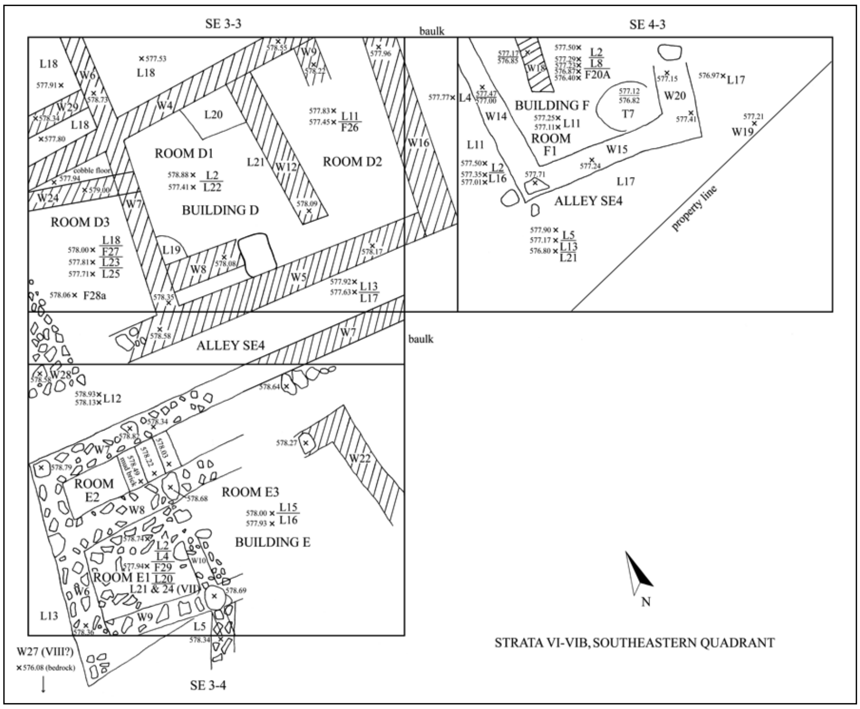


Fig. 9.16. Plan of the SE quadrant of Tell er-Rumeith.

9.4 Artefacts related to weaving

Weaving requires some procedures to produce a regular and tight weave. A type of comb or beater was used on the different looms.

Spatulas and shuttles

Seventeen thin and flat bone spatulas or spatula fragments showing a lustrous sheen were recorded from Tell er-Rumeith. They are comparable to the spatulas from Tell Deir Alla (Van der Kooij and Ibrahim 1989:99), Tell Ta'anach (Friend 1998:61-66), and Tell Jawa (Daviau 2002b:261, fig. 2.154:2).[108] It might be expected for several spatulas to be found together. This happened in two instances: 3 spatulas and some fragments (no. 315) were found in NE 2-3, locus 22, and a spatula (no .320) and some fragments in NE 3-2, locus 54, and Stratum VII locus (Iron Age). They were probably used or stored together.

Fig. 9.16. Spatulas 315a-c.

[108] For a complete overview of finds from the Levant see Daviau 2002:198-200.

Two thin bone tools from the site might have been used as shuttles: Shuttle 316b is a thin bone tool missing parts at the ends. Shuttle 316a is a thin bone tool cut in at the waist. They were found together in NE 3-3, locus 16, Iron Age Stratum VII.

Figure 9.17. Shuttles 316a and 316b.

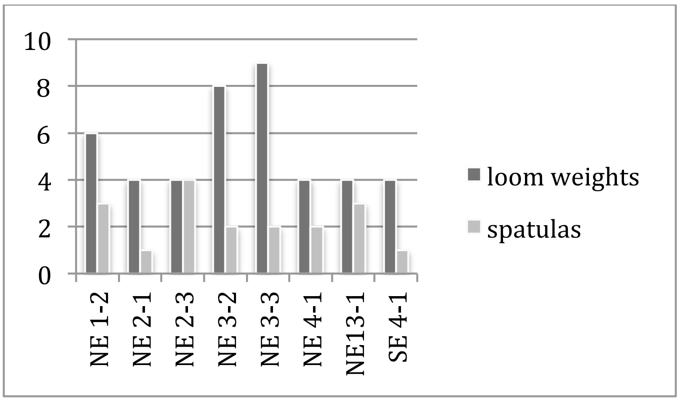


Fig. 9.18. Number of loom weights found in the loci where spatulas have been found.

9.5 Conclusions

It is to be expected that some implements used in textile production will be found together. The artefacts were probably stored together. However, in only a few instances at Tell er-Rumeith were artefacts found in the same locus. Unregistered loom weights were found in NE 2-3 locus 22 with the small cluster of spatulas (no.315), in NE 3-3 locus 16 (Stratum VII) with shuttles 316, with spatula 320 and some fragments in NE 3-3 locus 54, and with whorl 25, NE 3-2 locus 11. The clustering is so limited it is doubtful that the artefacts were in use at the time of destruction or abandonment.

Spindle whorls

Each spinner probably had several spindles because when the spindle is filled it has to be unloaded before it can be used again. In addition, an extra spindle of heavier weight was needed to ply two threads together. Producing yarn is very time-consuming; a skilled spinner can produce 14.16 g of yarn in one hour or about 114 g a day. Spindles were usually personal belongings; because spinning can be performed almost anywhere, spinners probably took their spindles with them. Spindle whorls can be expected all over a site. When not in use, they were probably stored, perhaps together with the other artefacts used to produce textiles. The seventeen excavated spindle whorls at Rumeith may indicate that about seven people were involved in spinning in the northeast part of the site. Spindle whorls are small and light so they may travel with their owners when leaving the site, but they can be easily left behind or lost.

Loom weights
Loom weights are sometimes found together in rows representing a functioning loom. Usually a set of ten or more loom weights was used on a loom. If the loom was not set up, loom weights were stored in baskets or pots and kept in the same storage rooms as the food containers (Boertien 2004:318-319). Iron Age loom weights are heavy, and we can assume that the inhabitants would not take them with them when leaving the settlement. Rumeith yielded 99 loom weights, but few from typical groups representing a loom. The loom weights at Rumeith are relatively light and small, suggesting that wool was woven.

Spatulas
Usually thin bone spatulas (fig. 9.16) are found together with loom weights, but this happened rarely at Tell er-Rumeith. The site yielded seventeen spatulas and two shuttles, which is a high proportion compared to the number of loom weights, suggesting that more looms may have been used within the fortress area than the loom weights indicate. The warp-weighted loom is not the only kind of loom used in this period. The simple vertical loom and the horizontal ground loom were used to produce large pieces of cloth. The wooden constructions of these looms do not leave traces in the archaeological record, although they might have been used at Rumeith. The number of spatulas found at Rumeith may indicate that they were used not only on the warp-weighted loom, but also on the horizontal ground loom and in tablet weaving (see Chapter 2.3).

Textile production
The limited number of whorls, loom weights and spatulas found at Tell er-Rumeith provides evidence for domestic weaving activity rather than industrial production. From the weights of both spindles and loom weights it is probable that the textiles produced in the areas excavated were made of wool and not linen, which was manufactured in the Jordan Valley. From the weight and shape of the loom weights it can be concluded that this yarn was woven into a medium-thick woollen cloth. The bone spatulas were used to create intricate coloured patterns in the woollen cloth, and perhaps multicoloured bands were also made at the site.

PART THREE

Interweaving the facts

Chapter 10 The loom weights of Iron Age Transjordan

In this chapter we will discuss the issue of increasing numbers of loom weights in the Iron Age and answer the question why so many have been found in this period in the Southern Levant. The study confirmed the idea that loom weights were made of local clays, but it also revealed that the 'clay balls' were made by professionals. The studied loom weights made it possible to design a typology of loom weights from Transjordan, in which regional differences are revealed.

10.1 Increasing numbers of loom weights in the Iron Ages

Loom weights from different sites in Jordan show that their number increases spectacularly in Iron Age II and this tendency is found all over the Southern Levant. The increasing numbers of (unfired) clay loom weights shows that the warp-weighted loom was used intensively in this period to weave fine textiles with coloured patterns. The increase in the numbers of loom weights found in the Levant from the Iron Ages reveals that the sophisticated pattern techniques already practised in Central Europe since the Neolithic also appeared in the Levant during the Bronze and Iron Ages (Chapter 3). The increasing number of loom weights in combination with the appearance of bone spatulas, both used to make intricate patterns in the weft on the warp-weighted loom, supports this conclusion.

The increasing number of loom weights is usually attributed to two circumstances:
- It is thought to be easier to weave on a flexible loom, and thus production could be increased, probably for export.
- The growing textile production might be related to the demands of the Assyrians (Browning 1988:154-158; Kelm and Mazar 1995:163). Indeed, in Assyrian tribute lists of Tiglath Pileser III (744-727 BC) the countries of Transjordan are explicitly mentioned: "…linen garments with multicoloured trimmings, garments of their native industries made of dark purple wool..." received from the kings of the southern Levant, including Sanipu of Bit Ammon, Salamanu of Moab, Mitinti of Ashkelon, Jehoahaz of Judah, Qashmalaku of Edom and Hanno of Gaza (Tadmor and Yamada 2011:122, ANET 282).[109]

The reason why this change in technique was desired cannot be answered from political considerations alone. External factors can never be the only reason for a change in textile production because textile production is highly traditional. Changes in textile production will take a long period of time as textile crafts form part of long-lasting family and regional traditions and as such are an important exponent of group identity.
The fact that patterned textiles were produced on the warp-weighted loom is part of the answer to the questions how, where and why more complex garments were made. More loom weights were required to weave such textiles. The increase in numbers of loom weights from different sites in the southern Levant does not start in the 7th century BC, when the Assyrians demand tribute, but much earlier. The use of the warp-weighted loom came to the Levant in the Bronze Ages and was a famous and settled tradition by the 9-8th centuries BC. Only later, in the 7th century BC, when using warp-weighted looms to produce patterned textiles was a recognized Levantine tradition, could the demands of the Assyrians follow. There are no indications that textile production was raised because of Assyrian demands. The change in the weaving technique was the first in this process of change, resulting in new and desirable textiles, known for their quality, colours and beauty, and thus used as tribute to be given to Assyrian kings (see also Chapter 1.7 and fig. 1.2).

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[109] But in the tribute lists of Senacherib 704-681 BC (COS 2.118i; COS 2.119B; ANET 287) and Esarhaddon 680-669 BC (Leichty 2011:46) no textiles from Transjordan are mentioned.

10.2 The clay of loom weights

Because no information was available on the clay used in ancient loom weights from Iron Age Jordan, a study of the fabrics used in these loom weights from Iron Age Jordan was undertaken.
The study of the fabric of the loom weights from Deir Alla was the first to be conducted. Fabric analysis was based on the pottery studies of Franken and Kalsbeek (1975) and Franken (1985). The studies of Niels Groot (2007, 2011) on the fabrics used for pottery production in Deir Alla were applied to the loom weights from Deir Alla. At Deir Alla phase IX all of the loom weights were made of a kind of clay that was also used to produce pottery, 20.7 % of the loom weights showed that some kind of extra temper was intentionally added, and 23.3 % of the loom weights were made of selected and levigated clay (Chapter 6).

The loom weights from Mudayna offered a new opportunity to study the fabric of loom weights. Loe Jacobs (ceramist) and Bram van As (archaeologist and pottery specialist) of the Department of Pottery Technology at Leiden University analyzed the clay of Wadi ath-Thamad (fig. 10.1). Loe Jacobs analyzed and studied the pottery and loom weight samples from Khirbet al-Mudayna situated on the Wadi ath-Thamad. This study resulted in new insights concerning the clay used to make loom weights (Chapter 8.3). Seven loom weight samples have been analyzed; four of which were made of clay that was suitable for pottery production, which means that they could have been fired, though this was not the intention. The clays used in the Khirbet al-Mudayna pottery that match the buff firing colour in most cases do contain Ostracoda, which were added to the clay. The loom weights made of this type of clay did not show the characteristic Ostracoda, because they were not meant to be fired and thus it was not necessary to add Ostracoda to the clay. The three other samples were made of very poor clays that could not be fired, but these samples did contain a certain percentage of fine organic material, which is comparable to the amount of fine organic material added to the pottery of Khirbet al-Mudayna. The loom weights were used unfired. Fine organic fibres were added in percentages between 2-5% in order to improve the cohesive strength of the loom weights, not only during forming, but also during use.

Fig. 10.1. Sampling clay in the Wadi ath-Thamad.

The clay analysis from both Deir Alla and Mudayna confirmed the idea that local clay was used to make the loom weights.The conclusion is that the selection of the clay and the additions added as temper to the clay used for loom weights is not accidental but planned, resulting in a technically correct material to make the desired loom weights. Iron Age unfired loom weights were made by people who were familiar with the technical abilities of clay and certainly knew why they used particular mixtures.

10.3 Typology of loom weights from Transjordan

To design a good chronological typology, chronological data are needed. These data can be found in the ceramic typology of well-stratified excavations. The work on the pottery and stratigraphy of Tell Deir Alla (Franken 1969, 1982, 1992; Vilders 1992: Groot and Dik 2006, 2008) forms the basis for a detailed relative dating system in Transjordan. The Iron II settlement Jordan Valley survey by Lucas Petit and Eva Kaptijn discovered 17 settlement mounds that encompass Iron Age material (Petit 2009).

Chronology

Tell Deir Alla can be regarded as an important type site in the archaeology of Jordan, therefore it seemed very promising to study the loom weights from this site. The loom weights studied by the author were limited to the weights from phase IX (and M) excavated up until the 2000 season, as those from other periods and later seasons were not available. The loom weights of Tell Mazar seemed a good alternative because the site is very close to Deir Alla and the ceramics have been studied in relation to the finds from Tell Deir Alla. Unfortunately the study of the ceramics has not yet been completed, therefore a complete chronological typology for loom weights found in Jordan seemed problematic. The recent publications by Petit (2009) and Groot (2010) on the chronology of Tell Deir Alla in relation to other sites in the Jordan Valley and especially to Tell Mazar opened up new possibilities for dating the loom weights. It is thus possible to design an indicative general chronological typology for loom weights from Iron Age sites in Jordan. The dating of the loom weights is based on the chronological information from the published excavation reports. A great help in these is the chronological typology published by Friend in 1998. Although it is a typology based on the shape of the artefact, it served as a well-documented reference collection. The recently published loom weights from Israel, Syria and southern Turkey were used as chronological parallels for the finds from Jordan (Chapter 6).

The objective data presented here depend on fiercely debated traditional foundations used in the chronology of the Southern Levant. The difference between high and low chronology will not influence the internal structure of the periodization because the periods are internally linked and based stratigraphically on cultural and social information from local data.

Period	**Dates**
Iron Age I	1200-1000 BC
Iron Age IIA	1000-925 BC
Iron Age IIB	925-725 BC
Iron Age IIC	725-539 BC
Persian Period	539-332 BC
Hellenistic Period	332-63 BC

Table 10.1. Chronology.

Lucas Petit (2009) adapted the chronology of the Central Jordan Valley by refining the stratigraphy of Tell Deir Alla in association with new data from the surveys of the *Settling the Steppe Project* and his excavations at Tell Ammata, Tell Adliyeh and Tell Damiyah. Niels Groot (2010) investigated the ceramic chronology of the Persian Period (Iron Age III) of Tell Deir Alla (phases VII, VI, V, IV and III). With the results of their work it was possible to refine the dating of Tell Mazar in order to be able to fit the results of my loom weight study into a chronological framework. According to Groot (2010:151), Mazar Stratum V is situated between Deir Alla phase VII and VI dated to the 7th century BC. Groot and Petit agree about Mazar Stratum V being contemporaneous with Deir Alla phase VII dated between 720/750- 680 BC. Groot and Yassine and Van der Steen (2012:82) date Mazar Stratum III contemporaneous to Deir Alla phase VI, which is dated to the 7th century BC. Petit dates Deir Alla VI to the 6th century BC, which in the case of Mazar III is too late because textual evidence shows that Mazar III can be dated to the 7th century BC, as confirmed by the ceramic investigations and dating by Groot. Mazar Stratum II is contemporaneous with Deir Alla phase V/IV according to Groot (2010:151) and Yassine and Van der Steen and (2012:82-83) and therefore can be dated to the Persian Period (Iron Age III) 6th century BC, contra Petit who dates Mazar Stratum II to the 5th century BC. According to Yassine and Van der Steen (2012:83) and both Petit and Groot, Tell Mazar Stratum I can be dated to the 4th century BC. The loom weights from Tell Deir Alla phase IX are dated to c. 800 BC (Van der Kooij and Ibrahim 1989:82), that is Iron Age IIB.

Tell Deir Alla (traditional)	**Tell Deir Alla (Petit 2009)**	**Tell Deir Alla (Groot 2010)**	**Tell Mazar (Groot 2010 and Yassine and Van der Steen 2012)**	**Tell Mazar (Petit 2009)**
Phase	Phase	Phase	Stratum	Stratum
Xa 1100-1000BC	K 1020-1000 BC Xa c. 980-950BC			
Xb 1000-980 BC	Xb 10th centuryBC			
	IX 820-780 BC	IX c. 800 BC		
IX 850-800 BC	VIII 780-760 BC	VIII Iron Age IIC		
VIII 800-750BC	VII 720-680 BC		V 720/750- 680 BC	V 750-680 BC
VII 750-680 BC	VI 630-600 BC	VII /VI 7thcentury	IV 7th century BC	IV 680-600 BC
	VI/V 6thcenturyBC	V/IV 6thcenturyBC	III end 7th century BC	IIIA 600-550BC
VI 650-590 BC				IIIB 550-500BC
	V 5th century BC		II 6th century BC	II 5th century BC
	IV 5th century BC			
	III 4th century BC			I 4th century BC
	II 4th century BC		I 4 th century BC	

Table 10.2. Dating of Tell Mazar and Tell Deir Alla.

Khirbet al-Mudayna can be dated to Iron Age II. This dating is based on the pottery according to Steiner 2006:104. Khirbet al-Mudayna was built at the end of the 9th or beginning of the 8th century BC and the destruction is dated to 700-600 BC.
The loom weights from Tell er-Rumeith are from strata VIII and VII. Stratum VIII is dated to the 10th century BC (according to Lapp 1975:114-115; Barako 2009:10). Stratum VII is dated to the mid-9th century BC (Lapp 1975:114,116, Lapp 1993:1292, Barako 2008, 2009:11). The Iron Age loom weights studied range from Iron Age IIA to the Persian Period (Iron Age III) and therefore can be used to develop an outline for a dated typology of Iron Age loom weights from Jordan.

Iron Age clay loom weights from Transjordan
900-800 BC Tell er-Rumeith Iron Age IIA
800 BC Tell Deir Alla (phase IX) Iron Age IIB
800-700 BC Tell Mazar (Stratum V) Late Iron Age IIB
700-600 BC Khirbet al-Mudayna Iron Age IIC
600-500 BC Tell Mazar (Stratum III) Late Iron Age IIC
500-300 BC Tell Mazar (Stratum II) Persian Period (Iron Age III)

Table 10.3. Iron Age clay loom weights from Jordan.

The loom weights; an overview

The loom weights from Transjordan will be discussed in relation to loom weights from other parts of the southern Levant. Only three loom weights have been recorded from the Early Bronze Ages (Friend 1998:35-36); their average weight is 248 g, ranging from 219-297 g (in fact too few weights have been found to calculate a meaningful average weight). In the Middle and Late Bronze Ages the weights range between 172-393 g, and the average weight is c. 300 g (Friend 1998:9). Iron Age I loom weights cannot be included in this overview because thus far no loom weights from this period have been found in Transjordan. In the Iron Age II period the average weight usually ranges between 300-400 g (Shamir 1996:140), but in some regions the average weight is higher. The average weight of Iron Age loom weights from the Jordan Valley ranges between 466 g at Tell Deir Alla (Boertien 2004:322) to 547 g at Tell Mazar Stratum III (Chapter 7. Tell Mazar). In Jerusalem (City of David) the range is 22.8-805 g (Shamir 1996: 143). In Kuntillet Ajrud the range is 240-310 g (Sheffer and Tidhar 1991:1-26). The loom weights of Tel Amal range between 90-420 g (Gal 1989:283). At Tell er-Rumeith the weights range between 69 and 706 g, and the average weight is 282 g. In the late Iron Age loom weights decrease in weight. At Khirbet al-Mudayna (dated to Iron Age IIC) the average weight is 248 g (see Chapter 8). In Tell Mazar Stratum V (Iron IIC) the average weight of the loom weights is 132 g (see Chapter 7). The loom weights of Tell Mazar demonstrate that in the late Iron Age small square loom weights were also being used. In the Persian Period anchor-shaped loom weights are large and heavy. In the Persian Period smaller donut-shaped, or pyramidal weights with an oval or round base were also being used, weighing less than 100 g, according to Shamir (1997). At Tell Mazar in the Persian Period heavy anchor-shaped weights (427 g) were being used together with medium-sized anchor-shaped loom weights with a more or less rectangular base. Medium-sized donut and spherical loom weights were also being used, and a new type was introduced: the lighter pyramidal loom weights (147 g) with a round or oval base. In the Southern Levant Hellenistic loom weights are predominantly pyramidal, weighing about 100-200 g (Shamir1996:151; 1997:2; Friend 1998:10). It is known that Hellenistic loom weights were sometimes mould-made (Gleba 2008:134). They tend to be numerous, small and light (Shamir 1995; 2004:26). The loom weights became progressively smaller, falling to an average weight of only 73 g in the Early Hellenistic period. The loom weights from Tell Mazar Stratum I (Early Hellenistic period) show various types, the donut-shaped and the spherical loom weight being dominant. These are unfired and small, weighing on average 40 g, almost miniature loom weights. The small pyramidal loom weight with a square base was being introduced. The loom weight typology can be found in Chapter 7.3.

Typology of Iron Age clay loom weights from Transjordan

The experiment (Chapter 4) and the study of loom weights from Tell Deir Alla (Chapter 6), Tell Mazar (Chapter 7), Tell Khirbet al-Mudayna (Chapter 8) and Tell er-Rumeith (Chapter 9) resulted in a typology for Iron Age clay loom weights from Transjordan.

A. Non-perforated loom weights, known as *spools* or *reels*. Only one such loom weight was found in Deir Alla (Chapter 6).

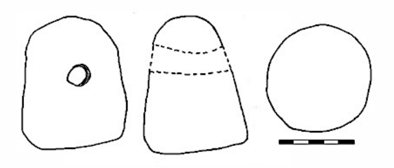
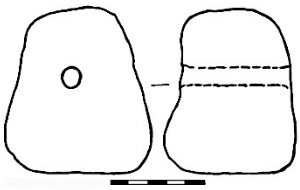
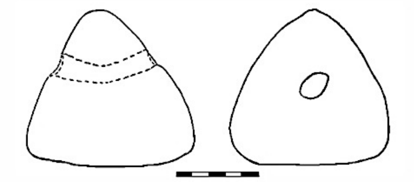
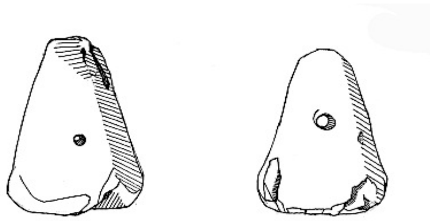
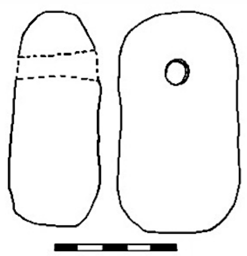
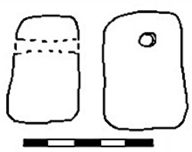
B. The perforated loom weights can be divided into two main groups; the main distinction is the position of the perforation: The *horizontally perforated loom weight (pendant-like loom weight)* and the *centrally (vertically) perforated loom weight.* Within these two main groups nine main types can be defined.

Horizontally perforated weights:

1) Conical loom weights are all kinds of cone-like weights.
2) The beehive-shaped weights are conical, flattened and have an extremely small perforation. Other authors often regard these weights as being conical loom weights, but they are different because of the small perforation and because two more actions are needed to produce this shape: making the loom weights flat at the base and flattening the top.
3) Pyramidal loom weights have either a square or a circular base.
4) Square loom weights.
5) Anchor-shaped loom weights are slab-shaped oblong loom weights, their bases being more or less rectangular or oval.

Centrally perforated weights:
6) The group of donut-shaped loom weights differs from those in a usual typology because here the bi-conical loom weights are incorporated. The donut-shaped loom weights have to be divided into two different groups: the regular donut being < 9 cm, and the large donut being > 9 cm, because they were made in different ways (see Chapter 4).
7) Spherical weights are ball-shaped loom weights.
8) Wheel-shaped loom weights are large, heavy, relatively thin loom weights.
9) Cylindrical loom weights are thick loom weights. Their weight is comparable to the donut-shaped loom weights and their height is only slightly greater than their diameter. Centrally perforated loom weights with a diameter between 5-7.5 cm were all produced in the same way, resulting in a group of loom weights of mixed type, comprising donut, biconical and spherical weights as well as cylindrical weights (see Chapter 4).

Typology
The study of 1480 loom weights from different regions in Transjordan offered the possibility to design a typology of Iron Age clay loom weights from Transjordan.

Horizontal perforation (pendant)	
Conical loom weight 	*Conical loom weight* Characteristics: Conical body with a circular or elliptical base. Diameter of the perforation varies from 0.5 to more than 2 cm. Iron Age IIb 8th century BC Iron Age IIc 7th - 6th century BC
Beehive-shaped loom weight 	*Beehive-shaped loom weight* Characteristics: Conical body flattened top and bottom. The narrow perforation always made with a stick in the middle of the weight measuring 1-1.4 cm in diameter. Iron Age IIb 8th century BC
Pyramidal loom weight (circular base) 	*Pyramidal loom weight* Characteristics: Pyramid-shaped body with a circular base; measurements differ. Diameter of the perforation varies, usually over 1 cm. Persian Period 5th century BC
Pyramidal loom weight (square base) 	*Pyramidal loom weight (square base)* Characteristics: pyramidal square body with a square base; measurements differ. Diameter of the perforation diameter varies, usually under 1 cm. Iron Age IIc 7th - 6th century Persian Period 5th century BC
Anchor-shaped loom weight 	*Anchor-shaped loom weight* Characteristics: height exceeds diameter, body and base elliptical or more or less flattened rectangular with rounded top with flat ends. Perforation diameter varies, usually over 1 cm. Iron Age IIc 7th- 6th century BC Persian Period 5th century BC
Square loom weight (small) 	*Square loom weight* Characteristics: Small loom weight with a flattened top and a square base. Perforation diameter under 1 cm. Iron Age IIc 7th- 6th century BC Persian Period 5th century BC

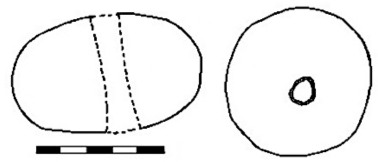
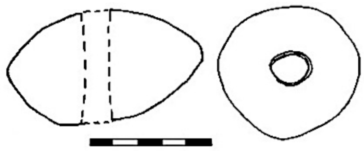
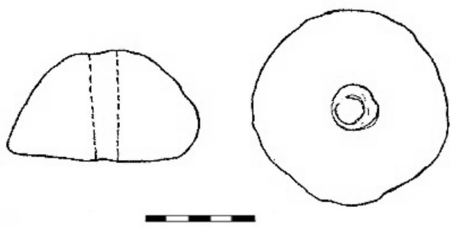
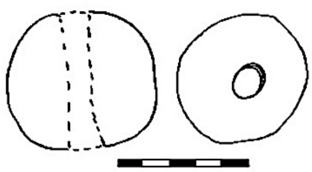
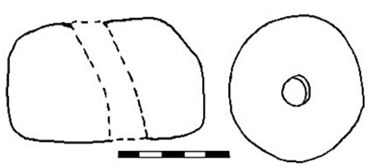
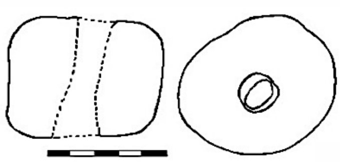
Central perforation	
Donut-shaped loom weight  a  b	*Donut-shaped loom weight* *Characteristics:* the weight was made from a coiled piece of clay < 9 cm, the coil was wound around the finger to create the shape. a. Donut-shaped loom weight (regular). Characteristics: less than 9 cm in diameter. Width 1 cm wider than height. Perforation diameter 1-2 cm. b. *Bi-conical weight*: a donut-shaped loom weight. The elliptical shape is non-discriminating, the weight was made in the same way as the donut-shaped weight, resulting in identical characteristics: Less than 9 cm in diameter. Width 1 cm more than height. Perforation diameter 1-2 cm. Iron Age IIa 9^{th} century BC Iron Age IIb 8^{th} century BC Iron Age IIb/IIc 8^{th}-7^{th} century BC Iron Age IIc 7^{th}-6^{th} century BC Persian Period 5^{th} century BC
Donut-shaped loom weight large 	*Large donut-shaped loom weight* The weight was made from a coiled piece of clay that was too long to be held in the hand or wound around the finger; the weight was shaped on a horizontal surface creating one flat side. Characteristics: > 9 cm in diameter. Perforated with a stick. Perforation diameter usually 1-2 cm. Iron Age IIb 8^{th} century BC Iron age IIc 7^{th} - 6^{th} century BC
Spherical loom weight 	*Spherical loom weight* Characteristics: Width and height vary no more than 1 cm. Ball-shaped loom weights are over 5 cm in diameter. Perforation diameter over 1 cm. Iron Age IIb 8^{th} century Iron Age IIb/IIc 8^{th}-7^{th} century Iron Age IIc 7^{th}-6^{th} century Persian Period 5^{th} century
Wheel-shaped loom weight 	*Wheel-shaped loom weight* Characteristics: Width more than 1 cm wider than height, more or less flat ends. Usually over 9 cm in diameter. Perforation diameter over 1 cm. Iron Age IIb 8^{th} century BC Iron Age IIb/IIc 8^{th}-7^{th} century Iron Age IIC 7^{th}-6^{th} century
Cylindrical loom weight 	*Cylindrical loom weight* Characteristics: Width and height vary no more than 1 cm, flat ends. Perforation diameter over 1 cm. Iron Age IIb 8^{th} century BC Iron Age IIb/IIc 8^{th}-7^{th} century Iron Age IIc 7^{th}-6^{th} century Persian Period 5^{th} century

Fig. 10.1. Typology of Iron Age clay loom weights from Transjordan.

10.4 Regional differences in loom weights

The name of a fabric often refers to the geographical origin of a the textile technique: gauze is a thin transparent fabric made in a technique originally from Gaza. Damask is a reversible figured pattern in the weft, it is made of wool, linen or silk, and the technique is originally from Damascus. Because the importation of textiles is rather easy, and craft traditions last over long periods of time, it may be assumed that loom weight types were used for long periods of time. Differences in shape and or weight can be attributed to technological requirements, and regional traditions can also be expected.

The weight of loom weights

The loom weights of Deir Alla, Tell Mazar and Khirbet al-Mudayna confirm the idea (Shamir 1996:146, 151; Friend 1998:9-10) that Levantine loom weights show an increasing weight during the Iron Age and reduce in weight in the Persian and Hellenistic periods. The weight of Iron Age loom weights ranges between 69 and 706 g and their average weight is 282 g. The loom weights of Tell er-Rumeith are comparable in size, weight and shape to those of Tell Khirbet al-Mudayna in Moab (Chapter 8), where the average weight is 242 g. The average weight of Iron Age loom weights from the Jordan Valley, on the other hand, ranges from 362 g at Tell Mazar (Chapter 7) to 466 g at Tell Deir Alla (Chapter 6). The loom weights of Tell er-Rumeith are thus lighter in weight than those from the Jordan Valley.

Jordan Valley east	**Moab**	**Hill country (north)**
Deir Alla: 466 g Tell Mazar: 362 g	Khirbet al-Mudayna: 242 g Mudaybi: 253 g	Tell er-Rumeith: 282 g

Table 10.4. The average weight of loom weights in areas east of the river Jordan.

Comparable regional weight patterns in loom weights can be found to the west of the River Jordan, where loom weights from the Shephelah and the hill country are lighter in weight than those from the Jordan Valley.

Jordan Valley west	**Shephelah**	**Hill country**	**Sinai**
Beth Shean: 350-450 g	Tell Miqne: 353.5 g Tell Ta'anach: 348 g	Jerusalem: 160.7 g	Kuntillet Ajrud: 250 g Kadesh Barnea: 98 g

Table 10.5. The average weight of loom weights in areas west of the river Jordan.

Shamir (2006:481) hypothesized that the weight of the loom weights possibly indicates that bast fibre or wool was produced. Because bast fibres need more tension on the loom than wool, the loom weights used to produce linen and hemp would tend to be heavier than those used to produce woollen fabrics. The weights excavated in Israel suggest that textiles made of linen were produced in the Jordan Valley, whilst woollen textiles were produced in the hill country. The finds from Jordan seem to show the same tendency: heavy loom weights in the Jordan Valley and lighter ones being used in the hill country of Gilead and Moab. More research on loom weights from the different areas is needed to confirm this idea.

Although there is a differentiation in regional production, it should be realized that it is still possible that some woollen cloth could also have been produced on the looms at the sites where mainly vegetal fibres have been produced, which were set up with smaller loom weights. The Central Jordan Valley is the southernmost region famous for its textile production, especially linen, in historical times.[110] Further research on spindle whorls and loom weights from these regions is needed to confirm this hypothesis.

Typological differences in loom weights

[110] In Mishna Kelim, the production of linen is mentioned situated in the valley of Beth Shean and in the Jordan Valley (Mishna Kelim 9:42), and in the Talmud the production of linen in the Jordan Valley is mentioned in the Midrash on Genesis Rabba 20.

The change in the type of loom weight cannot always be explained by technological change – the answer has to be sought in combination with cultural and/or economic changes.
The Iron Age Ammonite loom weights show a difference when compared to loom weights from other parts of Transjordan and Cisjordan. The loom weights of Tell Mazar, Tell Deir Alla and Tell Jawa suggest that the typology of loom weights in Iron Age Ammon is slightly different. All over the Southern Levant the donut-shaped loom weight dominated, but in Ammon the donut-shaped loom weight was always combined with other types of loom weights. At Tell Mazar Iron Age IIB donut-shaped loom weights were combined with spherical and cylindrical weights. At neighbouring Deir Alla phase IX dated to Iron IIB, donut-shaped loom weights were also being combined with spherical and cylindrical weights, but in Deir Alla conical and wheel-shaped loom weights were also being used, which are not so common at Mazar.[111] The combination of donut-shaped loom weights with spherical and cylindrical weights is also found in the 95 loom weights published from two different Iron Age strata from Tell Jawa, which is also situated in Ammon (Daviau 2002:191-198).[112]
In Iron Age IIC Mazar, anchor-shaped weights were used, together with elongated conical loom weights in combination with donut-shaped weights. Compared to Cisjordan, where the use of anchor shaped loom weights is typical of the Persian Period, their use in Ammon is early (see further Chapter 11.7).
The situation in Iron Age Moab is also different from Ammon because here mainly donut-shaped loom weights were being used, and hardly any anchor-shaped loom weights have been found at Khirbet al-Mudaybi dated to Iron Age II (Wade and Mattingly 2002) or at Khirbet al-Mudayna dated to Iron Age IIC (Chapter 8). These finds confirm the idea that the loom weights from Ammon were indeed being used in a different way, though the implications for the production of textiles cannot yet be estimated.

Transjordan and its relationship to the north
Surprisingly, research on loom weights from Iron Age II Tell Deir Alla (Chapter 6 and Boertien 2004) shows similarity in type with Iron Age II loom weights excavated at Tell Afis in northern Syria (Cecchini 2000). The Iron Age loom weights of Tell Deir Alla and the late Iron Age and Persian loom weights from Tell Mazar are very similar in style to the Iron Age and Persian loom weights from Ebla (Tell Mardikh) in Syria.
In Transjordan, influence from the north is found in different aspects of material culture. The plans of Iron Age Tell es-Saidiyeh and the Early Phrygian levels of Gordion in Anatolia (dated to c. 800 BC) show a striking resemblance. The organized plans and consistent features of cooking facilities and weaving equipment at Tell es-Saidiyeh are highly reminiscent of the remains from Gordion (Burke 2010:166), pointing to a similarity in the organization of textile production (see below). Iron Age Gordion yielded hundreds of loom weights and textile fragments. Analyses of the Gordion textile fragments have shown that cloth production at Gordion was sophisticated and made use of advanced techniques. The woven textiles were patterned and made of vegetable fibres, such as linen and hemp, and some of the coloured and patterned fabrics were made of a combination of linen and wool (Barber 1991:197; Burke 2010:153-157). At Ebla, an interesting tripartite-pillared building, very similar to the pillared buildings at Khirbet al-Mudayna in Moab, seems to indicate an even more surprising connection. The loom weights from Iron Age Ebla also show a close resemblance to the finds in the Southern Levant, which raises questions about who made what, for whom and why?

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[111] This difference might be due to the fact that Deir Alla phase IX is earlier than the Iron Age strata of Tell Mazar (see Table 10.2).
[112] Tell Jawa Stratum VIII dated to Middle Iron II yielded donut-shaped loom weights (including a number of spherical ones) and four cylindrical loom weights. Tell Jawa Stratum VII dated to Late Iron II yielded donut and wheel-shaped loom weights together with spherical weights and two anchor and one ring-shaped loom weight. The excavator did not differentiate between donut-shaped, wheel-shaped and spherical loom weights and called them all donut-shaped. Only the 'best preserved' weights were presented (Daviau 2002:194), but from the drawings can be seen that here too spherical and wheel-shaped loom weights were being used (Daviau 2002;260, fig. 2.150-2.151)
(Daviau 2002:191-198).

The answer to these questions might be found in the history of the warp-weighted loom. In the Jordan Valley the influence from the north is visible in the language of the Balaam inscription. The loom weights of Deir Alla dated to c. 800 BC are similar to those from northern Syria. The stone artefacts from Deir Alla show a northern or northeastern influence (Petit:1999:157). Because production of linen is documented in later periods and flax seeds have been found at different sites in the Jordan Valley (Chapter 6.4 group XIII; Van der Kooij1989:34-35; Petit 2009:224), it can be assumed that flax was grown and linen was produced in the Jordan Valley. The fact that hempen textile has been found at Deir Alla suggests that hemp might also have been produced in the Jordan Valley (Chapter 6.7). The similarity between loom weights from northern Syria and Deir Alla and the textile fragment from Deir Alla suggest that bast fibres were woven on a warp-weighted loom. Possibly the northern influence, visible in material from Iron Age Jordan Valley, is due to the kinds of raw materials used to spin and weave.

Although transporting textiles was easy and common, the warp-weighted loom travelled all the way to the Levant. So why use a warp-weighted loom? The technique was innovative; making patterned textiles was easier on a warp-weighted loom. When taking into account that the warp-weighted loom travelled from Central Europe to the Levant and in its countries of origin it was used with bast fibres, it is tempting to conclude that this is the reason why the warp-weighted loom was introduced into Syria and the Southern Levant. Did people exchange technical knowledge on the production of bast fibres leading to a similarity in artefacts and traditions in the Jordan Valley and Northern Syria, or did they move from the north into the Jordan Valley bringing their knowledge and traditions with them? Because the processes seems to be very slow, ranging from Middle or Late Bronze Ages into Iron Age IIB, it seems more likely to point to some kind of exchange of techniques and ideas resulting in new developments in textile craft.

Chapter 11 Reconstruction of textile production in Iron Age Transjordan

The results from the study of the artefacts and the textiles provided a framework for the reconstruction of textile production. In this chapter the output of the warp-weighted loom will be discussed, and textile production and trade in Iron Age Transjordan will be analyzed and reconstructed.
Textile production and trade can be divided into three main questions: what kind of textiles were made, who produced the textiles, and how was the distribution of textiles organized. In this chapter I will argue that in Transjordan linen, hemp and wool fabrics were produced by professional weavers, both in domestic and in public space for private as well as communal use. The modes of production and the output of textile production will be estimated using archaeological finds associated with textile production from the Jordan Valley (Deir Alla, Mazar and Saidiyeh) and from Moab (Mudayna).

11.1 What kinds of textiles were produced?

Transjordan produced linen, hemp and wool as well as combinations of linen and wool. Hardly any visual material is available of the textiles used or produced in Iron Age Transjordan. A small statue of King Yerach Azar of Ammon (fig. 11.1) was found in Amman showing a barefooted man holding a lotus flower in his left hand. The statuette clearly shows the clothes of the man: he is wearing a pleated (folded) garment with short sleeves. On top of the garment the man wore a shawl/mantle slung around his waist and flung over his left shoulder. The loose end of the shawl was then draped over his right shoulder so that the decorative trimmings and tasselled end were hanging from his right shoulder. Underneath the shawl a belt is visible with trimmings, fringes and a cross pattern.

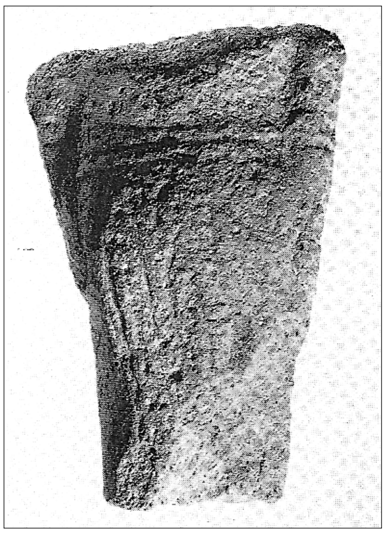

Fig. 11. 1. Statue of Yerach Azar son of Zakir son of Sanipu with traces of red paint, found in Amman and dated to the 8th century BC. (Van der Kooij and Ibrahim 1989 fig. 74). (On display in The Jordan Museum Amman).

Fig. 11.2. Female terracotta figurine (DA 152) (Van der Kooij and Ibrahim 1989 fig.75).

The bearded king is wearing a cap made out of patterned (woven) bands. According to Vogelsang-Eastwood (1989:61), the artist was trying to depict linen rather than a woollen garment as it is difficult to pleat wool in this way. It was, however, a traditional and common practice to pleat linen garments in this way and many such pleated garments have survived in Egypt. Such a pleated garment can also be seen on a fragment of a female terracotta figurine from Deir Alla (fig. 11.2). The remnants of the figurine show a pregnant woman wearing a belted and pleated (linen) dress. Fig. 11.3 shows the statue of an unknown Ammonite king wearing the same kind of garment as King Yerach Azar, but his headdress is different, it is supposed to be a typical Ammonite hat.

Fig. 11.3. Statue of a barefooted Ammonite king wearing a folded garment with short sleeves and an Ammonite hat. (On display in The Jordan Museum Amman).

Textual evidence on textiles is limited. The Assyrian tribute lists mentioning textiles from the Levant are a reliable and interesting source (see also Chapter 1). Textiles are attested exclusively in the lists of tribute, and never as booty (Yamada 2000:267). The tribute lists of Tiglath Pileser III mention 'Multicoloured garments, linen garments with multi-coloured trimmings, garments of their native industries made of dark purple wool' received from the kings of the southern Levant (Tadmor and Yamada 2011: 122, ANET 282). Lamb hides dyed purple and wild birds with blue-dyed spread-out wings are mentioned as tribute sent from the Levant to Tiglath Pileser III (Tadmor and Yamada 2011:58, 122-123; ANET 283). The delivery of elaborately coloured and patterned textiles is also attested from the Neo-Assyrian reliefs of King Ashurnasirpal II (883–859 BC) (Yamada 2000:268, note 108). Thomason (2010:198-203) studied the reliefs and the texts and noticed that the figures on the reliefs are wearing richly patterned textiles. Intricately patterned designs are carved on the robes of the king and his attendant, for example hunting scenes, couchant gazelles and 'trees of life' and various apotropaic figures. From the texts he lists multicoloured overcoats, coats, white linen caps, red leggings, tufted wool bedspreads, felted shawls and fringed blankets. Thomason's study gives us a more complete picture of what the textiles looked like and demonstrates the high standard of textiles used by the Assyrians (fig. 1.2). The tribute lists of Tiglath Pileser III and Shalmaneser III mention all kinds of desirable goods, among which are 'garments of their native industries' indicating that textiles from the Levant were desirable goods for the Assyrian kings.

Some texts from the Hebrew Bible shed light on textile production.
Linen: Stalks of flax were stored and dried on the roofs of houses, probably to be used in the production of linen, Josh.2:6. I Chron. 4:12 mentions the families/clans of linen workers at Beth Ashbea, and combed flax is referred to in Isa.19:9.
Wool: In Kings 3:4, Mesha the king of Moab is mentioned, giving lambs and wool to the king of Israel, suggesting that Moab paid wool as a tribute to Israel. White wool from Zahar being sold to Damascus is mentioned in Ez. 27:18, and curtains made of goat hair were to be made for the tabernacle, Ex. 26:7.

Specialized crafts are mentioned in post-exilic parts of the Hebrew Bible: weavers and embroiderers in blue, purple and scarlet, and in fine linen (Ex.35:35). In Ex.26:1 a reference can be found to ten curtains to be made for the tabernacle, they were made of finely twisted linen and blue, purple and scarlet yarn, with cherubim 'worked into them'[113] by a skilled craftsman. The prohibition on wearing garments made of two different kinds of fabric (Lev.19:19 and Deu.22:11) is discussed in Chapter 12. It can be concluded that the quality and standard of Levantine textiles was high. The local textiles were linen garments and linen garments with woollen trimmings woven in coloured patterns (Chapter 1). But other materials were also used to create precious textiles, such as fine hempen cloth (Chapter 6), and included cloth made of combinations of vegetal yarn and wool (Chapter 12), curtains of goat hair, textiles made of wool dyed in various colours and woven into intricate patterns, as well as coloured embroidery in blue, purple, scarlet and (white) linen (Chapter 2).

11.2 Who produced the textiles?

Spinning and weaving is supposed mainly to be women's work because these activities were time-consuming and could be combined with caring for children and with baking and cooking. Exceptions can be seen in Egypt and in some cases when technologically new looms are being introduced (Brown 1970; Barber 1994:294; 2007:173-174). It is known that free women from different periods and countries wove for their own profit. The archives found in Kanesh (Anatolia) show how women in Ashur were in business for themselves, producing and trading textiles (Veenhof 1972; Michel and Veenhof 2010:210-226). Barber (1991:260-382) studied textile production in the classical Greek world from texts, textiles, artefacts and illustrations and she concludes that mainly women were involved in textile production. Warp-weighted looms have been depicted in Greece and only women can be seen weaving on them (fig. 11.4).[114]
In Linear B texts, lists of persons occupied in textile production have been preserved and it can be seen that women produced the textiles (Killen 1964; 1966; Ventris and Chadwick 1973:578). Texts and finds from the Mycenaean world demonstrate how part of the textile production was connected to the palaces. Instead of merchants reselling textiles made by weavers, there was a direct link between the palace and the women manufacturers.

[113] Not mentioning whether the patterns were woven or embroidered is a safe translation because it is unknown whether the patterns were embroidered or woven into the curtains. [NET Bible New English Translation Bible (1996), NIV New International Version (1973), NASB New American Standard Bible (1960; 1995), MSG The Message (1993; 2002), BBE Bible in Basic English (1949/1964) and NRSV New Revised Standard Version (1989)].
[114] Barber lists the following pictures: a Greek vase from Chiusu, Italy (Furtwangler:1932, plate 142 in Barber 1991:fig. 3.26); a small vase from Corinth c. 600 BC (Barber 1991:fig. 3.24) and an Attic Greek lekytos c. 560 BC (fig. 11.4).

Fig. 11.4. Scene on an Attic Greek lekytos dated to 550-530 BC, showing a group of women spinning, weaving, weighing wool and holding (folding?) a piece of finished cloth. (Barber 1991:72, fig2.38. The Metropolitan Museum of Art, Fletcher Fund, 1931: no 31.11.10 © Princeton University Press).

The link between the palace and the women was a piecework system. Though some women lived and worked in groups concentrated around the palace, many others lived scattered about the towns and countryside (Barber 1991:283-284). In Egypt, tomb paintings and wooden models from the Middle Kingdom (2050-1650 BC) show women organized in workshops producing the whole cloth from start to finish. The pictorial art shows that from the 18th Dynasty (c. 1550 BC) onwards some male weavers start to appear, together with a new kind of loom, the vertical two-beam loom (Chapter 2), producing tapestry whilst women continued to weave the linens and garments (Barber 1991:258).

In the southern Levant no illustrations have survived of people weaving; in the Hebrew Bible spinning and weaving are referred to as mainly being women's work Judges 16:13-14; Proverbs 31:13; 2 Kings 23:7. But in Exodus 35:35 two men are mentioned as being specialists in textile crafts. Most authors agree that women carried out the weaving; in this respect some authors even go a step further, suggesting special areas of the house were women's activity areas (Cassuto 2008; Yasur Landau, Ebeling and Masow 2011:292-293).

Professionals

From the excavated textiles of Deir Alla, Kuntillet Ajrud and Kadesh Barnea it can be seen that skilled hands made the textiles. The weavers were professionals, but it is unknown whether the weavers who made these textiles were full-time professionals.

Communal activity

Barber (1994:18,176) points to the interesting fact that weaving was often a communal activity. Warping a loom is a time-consuming activity that is hard to do without assistance. This is recorded in Greece where the garment made for the goddess Athena was woven on a warp-weighted loom. Two women were required to set up the warp and then three women worked full time for nine months weaving the garment (Barber 1991:360-365) (see Chapter 11.9). Many ancient representations show two or three women weaving simultaneously on the warp-weighted loom (fig. 11.4).

11.3 Under what conditions were the textiles produced?

Weaving and the storage of loom weights was usually undertaken within the household, as can be seen from the find spots of the loom weights at Deir Alla. The units of Stratum IX seem to be private houses, but the huge scale of textile production may have been associated in some way with the functioning of the cult room devoted to Balaam (Chapters 6 and 12). It is known from other Iron Age sites that loom weights were also used and stored in public areas, as can be seen at Khirbet al-Mudayna. Thus far the excavations at Mudayna have revealed only public buildings and no private houses. The looms that could be identified stood mainly inside and on the roof of three tripartite-pillared buildings, and in a weaving room between the temple area and one of the pillared buildings (Chapter 8). The finds from Mudayna point to textiles produced for communal use, and perhaps to a centrally organized way of textile production, or perhaps even centrally organized storage facilities.

Weaving as a seasonal activity?
Brittnell (1977:239) suggested that weaving might have been a seasonal activity and the loom a temporary structure that could be readily assembled for a specific project. Loom weights found in storage together with pottery and grinding implements might point in this direction. Loom weights stored with grinding implements and pottery were found in Tell Deir Alla (Chapter 6). At Tell Ta'anach in the cultic structure, a hoard of donut-shaped loom weights was found in a eight-handled krater, together with pottery, 'jars still containing quantities of grain', cooking pots, knives, lamps and grinding implements (Lapp 1943:28, fig. 13). A study combining analysis of organic temper in loom weights with research on botanical remains and pollen from one and the same sites may shed light on the seasonal aspect of textile production.

11.4 Model for the organization and distribution of textiles

Very few hard and reliable facts can be found about the distribution mechanisms of textiles in the Levantine Iron Ages. It can be assumed that textiles changed hands to be used in the household, as gifts, as status items, for religious use and as tribute. Possibly textiles were sold or exchanged in the workshop, alongside the road, in markets or through traveling middlemen.

Exchange
Costin (1991:1) is right when she states: 'Exchange events are invisible in the archaeological record while production events often leave a clearer and more easily interpreted record in the form of debris, tools and features, if not the products themselves.' To remedy this a general approach will be chosen, examining economic models developed in archaeology and anthropology to analyze the trading of crafts. Data on textile exchange from other periods and/or places attesting how textile production was organized in antiquity will be explored.

Models for the organization and distribution of crafts
Since Childe (1936) addressed the link between craft production and complex society, defining a complex society as stratified, this relationship has received a great deal of archaeological research and attention (Neufeld 1960; Sahlins 1974; Wirth 1978). Many different models have been designed to describe and analyze production processes within social systems. Claessen and Skalnik (1978) developed a model for the Early State studying historically recent or still existing societies that were experiencing statehood for the first time in their history. Within the study of the Early State, a major topic has been whether or not specialized craft production is representative of an increase in social complexity (Earle 1987:75). Some scholars wonder whether a complex society is the cause or the effect of craft production (Clark and Parry 1990).
Focusing on the organization of society resulted in some interesting models designed for the production and distribution of crafts (Brumfiel and Earle 1987; Costin 1991). The model designed by Costin (1991) is interesting because one of the parameters emphasizes the spatial nature of specialization. Costin's context examines the political and socioeconomic conditions under which craft producers work, indicating attached and independent specialists. Cannon (2010) used this model in his study on the textile production and social organization of Karatas (ancient Megarsus) in Anatolia, and it seems attractive in the case of textile production in Iron Age Transjordan. But the model is designed for a situation in which information on political and socioeconomic contexts is available, and in which the finds from other excavations in the field of the specialization can be used. The parameters to define specialization and contexts (social stratification) cannot be constructed from the material of Iron Age Transjordan. The material from Transjordan requires a restricted model in which the different parameters can be identified. I used the model developed by Van der Leeuw (1977) to create such a model, combining aspects of technology and organization originally designed for the process of pottery production and distribution. Though the technical aspects in the production of pottery differ in many aspects from those in textile

production and trade, the economic aspects of the modes of production of specialized craft as distilled by Van der Leeuw can serve as a framework for the study of textiles.

Modes of production in the organization of textile production

Van der Leeuw distinguishes seven modes of production, each one with its own characteristics regarding scale, technology and organization. Peacock 1982, Duistermaat 2008 and Steiner 2009 (*inter alia*) have all applied Van der Leeuw's ideas to describe and analyze the economic aspects of pottery production in different regions. In his model Van der Leeuw distinguishes three main characteristics: scale, technology and organization in different modes of production. Due to the difference in material and craft some aspects of the model will be adapted based on what is known from texts on the production and distribution of textiles from Assyria (Veenhof 1972 and Michel and Veenhof 2010), Mesopotamia (Bongenaar 1997 and Zawadzki 2006) and Anatolia (Burke 2010:108-160). The information from the texts will be applied to Van der Leeuw's model to design an outline for a new model.

Assyria - Karum archives; traveling middlemen in the textile trade

The records of the Old Assyrian traders found in the archives of their houses in the commercial quarter (Karum) in the lower town of the ancient Anatolian city of Kanesh (modern Kültepe), dating from the 19th and 18th century BC, are unique accounts on textile production and trade (Veenhof 1972). Though this famous example is from a period much earlier than the period discussed here, due to lack of information on the textile trade in Iron Age Levant it will be used to demonstrate how textiles could have been traded in the Iron Ages. Using this example can (partly) be validated by the fact that the production of sophisticated textiles in Assyria can be attested as an ongoing tradition from the Old Assyrian Period via Middle Assyrian times, into the Neo-Assyrian period (Thomason 2010:198-203).

Anatolia was rich in silver, gold and copper, but to alloy copper into a bronze tough enough for tools and weapons the local people needed tin as a hardener. The Assyrians had access to sources of tin far to the east of Assyria, and this they transported westwards, across the continent, first to Assyria and then part of it was traded onwards to Syria and Anatolia. The metal traders also imported quantities of woollen textiles from their hometown, Ashur, into Anatolia. On their way to and from Anatolia they also conducted business in textile products in northern Mesopotamia, and they were engaged in trading locally produced textiles within Anatolia. The archives contain an number amount of references to a large variety of textiles. They tell about their transactions with the local king, and his deputies who inspected the goods from each incoming caravan and took a portion of textiles as tax before allowing the merchants to start selling the rest on the open market in Kanesh. The archives also revealed many of the letters the traders' wives, sisters or mothers wrote to them from far-away Ashur, letters not only on family affairs, but also about trading matters. Some of the women were in business for themselves, acting as textile suppliers to their fathers, husbands or brothers 950 km away in Anatolia (Veenhof 1972; Barber 1994:164-184; Michel and Veenhof 2010:210-226).

From the texts found in Kanesh, the following conclusions serve the model - There were no itinerant weavers, middlemen transported the textiles up to 950 km away. Textiles were used in long-distance trade because they can easily be carried together with other more heavy products, or they were used as wrappings for metals, metal objects, precious stones, etc. (Michel and Veenhof 2010: 217). The trade in ready-to-wear garments was only small. The trade in wool fabrics mainly concerned textiles of standard sizes in the shape of large sheets (Michel and Veenhof 2010:261). Textile crafts are valuable and easily transportable, making them an ideal and valuable trading item. Textile crafts have very strong regional traditions, making the textiles a desirable product outside the region where they were made.

Mesopotamia - Ebabbar temple accounts. Specialized workshops producing luxury or special kinds of textiles for the palace and the temple are attested in Mesopotamia. In the Ebabbar temple in Sippar woollen textiles were produced for the statues in the temple, and for the priests serving in the temple complex; the archives are dated to 635-434 BC (Bongenaar 1997; Zawadzki 2006).

Anatolia – Gordion. In Iron Age Gordion (Anatolia) the weavers lived together in a town quarter, specializing and producing different kinds of luxury textiles, such as fine linen, patterned and coloured woollen cloth, hempen cloth and also cloth made of linen in the warp combined with wool in the weft (Burke 2010:108-160).

The model

In the following model, six modes of production based on Van der Leeuw (1977) can be distinguished, each one with its own characteristics regarding scale, technology and organization. The exchange mechanisms of the different modes of production vary. The clientele for which the weaver produced could be the own household, the village or town, or a much wider region. The client goes to the workshop of the weaver or to the market; middlemen could distribute textiles from one or more workshops over a wider region.

In pottery production, individual potters can produce for a market outside the town region as itinerant potters, travelling in a region where they build a kiln and make pottery from local clay. Itinerant weavers are unknown because textiles are easy to transport. Weavers do not have to travel to be able to produce for a market outside their own region. The textiles can be transported by the client or traded via middlemen across a wide area.

A model for the organization of textile production and trade

1. *Household production* involves occasional production for use within the own household only, with little investment in time and technology. *Households producing a limited range of utilitarian textiles for their own use.*

2. *Household industry* involves part-time professionals producing at the household level for group use. *Small workshops producing a wide range of textiles for group use.*

3. *Individual industry* is a part-time or full-time professional weaver producing *luxury textiles* for the own town, village and also for export in the wider region. Distribution of textiles through middlemen is a well-known and documented phenomenon in textile trade from the Karum archives in Kanesh (Anatolia) (Veenhof 1972, Barber 1994:164-184; Michel and Veenhof 2010:210-226).

4. *Workshop industry* is the situation when a full-time weaver and her/his family or hired help run a workshop and provide textiles for the village, town and/or temple and/or palace, and also for the wider region. Workshop industry can also be *specialized workshops* producing *luxury or special kinds of textiles* for the village or the town and/or for the palace or the temple. Such an organization model is known from the Mesopotamian Ebabbar temple archives (Bongenaar 1997 and Zawadzki 2006). Workshop industry can also provide *luxury regional textiles* for a wide region traded via middlemen as documented in the Kanesh archives (Veenhof 1972; Barber 1994:164-184; Michel and Veenhof 2010:210-226).

5. Village industry is the situation when several weavers live clustered together in a village or town. The weavers tend to specialize, so that each weaver produces one kind of (luxury) ware. Such a mode of organization was found in Iron Age Gordion in Anatolia (Burke 2010:166-167).

6. Large-scale industry produces textiles on a regional scale in a market economy. This type is not found in the Iron Age.

11.5 Applying the model to sites in Iron Age Transjordan

By applying the modified model for the organization of textile production and trade to sites in Iron Age Transjordan, an outline can be sketched of the organization of the textile industry.

The textile tools from Khirbet al-Mudayna were found in or on public buildings and the production there was most probably meant for communal benefit. Therefore the production can be characterized as individual industry or perhaps even as workshop industry.

The number of loom weights at Deir Alla means the production there can be characterized as huge; the mode of production can be characterized as *household industry*, where production was undertaken by part-time professionals producing at the household level for group use or for a local market. A more likely possibility is that production was at the *workshop industry* level. The textile fragment and the threads found were made of hemp, which is an uncommon textile in the region and the fine fabric was skilfully made. These aspects point to *workshop industry,* where full-time professionals ran workshops producing for a wider region (see also Chapter 12).

Tell Mazar Stratum V (Iron Age IIB/C, 8th-7th century BC) is characterized as a non-military Ammonite structure. Stratum V consisted of a building with a medium-sized square courtyard with the floor paved with flagstones. One of the rooms yielded storage jars and 56 loom weights. The loom weights were used to make patterned cloth. The finds can be interpreted as individual industry. Because patterned textile was being made, it is possible that this was workshop industry. In this period Ammon was a vassal of Assyria, but whether the workshops were part of the industry producing textiles as tribute for Assyria cannot be derived from the finds at Mazar. Tell Mazar Stratum III (Iron Age IIC, 7th-6th century BC) revealed traces of a massive building in the centre of the mound. The elaborate building has been characterized as a palace and the excavators called it the 'Palace Fort'. According to Yassine, Tell Mazar was probably built by an Ammonite king as a garrison city rather than as a large settlement of the usual type (Yassine 1988:85). The weaving took place in a concentrated area of the site to the north of the palace. The finds might point to weaving for the palace, which as Ammon was a vassal of Assyria might also indicate the weaving of special kinds of cloth as tribute for Assyria.[115] The mode of production can be characterized as *workshop industry.* Since the existence of the palace cannot be attested in the final publication (Yassine and Van der Steen 2012:10-12), it seems more likely that a form of *individual industry* is applicable to this phase of Mazar.

Tell Mazar Stratum II (Persian Period, 5th-4th century BC) consists of private houses built along two sides of a central open courtyard. Weaving was undertaken in the northern part of the structure and can be characterized as household production or household industry, and even individual industry may be considered.

Tell es-Saidiyeh in the Jordan Valley yielded buildings used for textile production. Pritchard, who excavated and published the site, interpreted the structures of Stratum V as domestic houses with lots of loom weights. He published plans and pictures showing where the loom weights had been found (Pritchard 1985:15-38; figs. 52, 73, 74, 88 and 89). Figure 170:1 shows a group of loom weights and an impression of woven cloth on clay from house 16 in Stratum V. Brendan Burke (2010) has rightly interpreted the organized building plan of Tell es-Saidiyeh with the loom weights as an industrial quarter (fig. 11.5 and 11.6). Tell es-Saidiyeh with its specialized

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[115] The tribute lists from this period do not mention textiles from the Transjordanian kingdoms/tribes.

In the tribute lists of Senacherib (704-681 BC), listed among the kings of Sidon, Arvad, Byblos and Ashdod are also Buduili of Beth Ammon, Kasussun Abdi of Moab and Aiarammu of Edom. They kiss his feet and bring gifts to him, and quadruple their heavy *tamartu* presents (ANET 287).

Esarhaddon (680-669 BC) writes that he called up the kings of Hatti, but no tribute is mentioned. Among them were the kings of Tyre, Byblos, Arvad, Gaza, Ekron and Ashkelon, as well as Manasseh king of Judah, Qashgabri king of Edom, Musuri king of Moab and Buduili king of Beth-Ammon, but no mention is made of tribute. The tribute paid to Esarhaddon from Sidon is again described as '..garments made of linen and multicoloured trimmings..' (Leichty 2011:46; ANET 291).

workshops within a highly organized industrial quarter can be regarded as an example of *village industry*.

11.6 Production estimation

Reconstruction of textile production in Iron Age Transjordan requires different aspects to be studied. The main source of information is the textiles and artefacts used in textile production, of which looms can be regarded as the most important. The loom weights forming part of warp-weighted looms and the huge amounts of loom weights recovered from excavations, apparently intensively used during the Iron Ages, are the most prominent artefacts. Combined with other artefacts used in textile production, ethnographic information and results from experimental archaeology, it is possible to roughly estimate how much and what kinds of textiles were produced.

Production estimations based on loom weights

In order to deduce the numbers of looms represented by the recovered loom weights, parameters of loom requirements must first be established.

The parameters for loom requirements

The parameters for loom requirements can be found in ethnography, experimental archaeology and in the archaeological record.

- Approximate width and height of a warp-weighted loom
- Number of loom weights used on a loom
- Weight of loom weights
- The shape of loom weights (especially the width-thickness ratio of the loom weight)
- Implements used while weaving
- The kind of yarn used on the loom
- Place where the weaving took place
- Weaving output

Ethnographic information

The warp-weighted loom was used in the Levant into the Roman period when it was replaced by the upright two-beam loom without loom weights (see Chapter 3.1 and fig. 3.6). In Scandinavia the warp-weighted loom was used until about AD 1950. Ethnographic records from 20th-century Norway and Lapland provide interesting and relevant information on the use of the warp-weighted loom (Hoffmann 1974).

Information on the output of weaving, the production estimation, can also be derived from other kinds of looms than the warp-weighted loom. When circumstances are comparable, we can compare the output of other types of looms to the output of the warp-weighted loom. Weaving performed by skilled weavers on the horizontal and the standing loom in pre-industrial societies can thus shed light on the production of the warp-weighted loom. Sources for this kind of information can be found in various ethnographic publications. For the Levant, the most interesting publication is Gustaf Dalman's *Arbeit und Sitte in Palästina* (*Band V: Webstoff Spinnen, Weben Kleidung* (1937/1964). Other kinds of publications not specifically devoted to the production of textiles can also be very helpful (Glob 1999).

Experimental archaeology

Avigail Sheffer has reproduced a warp-weighted loom based on information from groups of loom weights recovered from the excavations of Tel Beersheba and on Iron Age II Greek pottery paintings depicting weaving on a warp-weighted loom. Her reconstruction resulted in a narrow warp-weighted loom using handspun wool (Sheffer 1981). Since then reconstructions have been performed by Idelin with the loom weights of Tel Miqne (Ekron) and by O. Levy at En Yael (Shamir 1996:144, photos 17-19). Orit Shamir performed experiments with the loom weights of

Tel Dor (mentioned in Shamir 1996:145), Tel Batash (Timnah) (Kelm and Mazar 1995:163, fig. 8.25) and with the loom weights of Masada (Shamir 1994b:282).
For a long period of time textile research in Near Eastern archaeology focused on historical-philological information because a great deal of information on textiles and textile production was present in the texts (such as Oppenheim 1949; Killen 1964; 1966; Veenhof 1972; Waetzoldt 1972; Lackenbacher 1982; Van Sold 1990; Bongenaar 1997 and many others). Experimental archaeology was only later introduced as an additional approach. In Near Eastern Archaeology the experiments were performed by archaeologists and not by skilled craftsmen, in contrary to European archaeology where there is a long tradition of experimental archaeology (Gillis and Nosch 2008:vii; Andersson Strand 2010b). European textile research uses a cross-disciplinary approach, involving archaeology, natural sciences and crafts. Skilled weavers perform the experiments revealing valuable and detailed information regarding technique and craftsmanship. The results of such an approach can be seen in the reconstructions based on weaving experiments by Ræder Knudsen (1998, 2002, 2007), Bender Jørgensen (2005), Andersson (2005) and others. At the Danish Centre for Textile Research (TTT Copenhagen), experiments revealed that the thickness of a loom weight controls how closely the threads of a particular diameter will be spaced in the fabric (Andersson Strand 2010:18). The ongoing influence of experimental archaeology on textile research can also be found outside Northern European Archaeology (Stauffer 2002; Von Eles 2002; Gleba 2007; Andersson Strand 2010; Burke 2010). In the Near East such interdisciplinary research is now being initiated.

Archaeological finds
Archaeological finds supply valuable evidence on loom weight usage. Friend (1998:7) describes it as follows: "The presence of rows of loom weights found in situ indicates that the warp was attached to a warp-weighted loom when the site was abandoned or destroyed. As the threads deteriorated or were destroyed, the weights would fall in the line they had been in on the loom."
Many loom weights have disappeared from the archaeological record due to external influences, and many loom weights have not been recognized as such in excavations. Some excavators do record loom weights, but they do not publish pictures or drawings of the loom weights in situ, making reconstructions of textile production impossible. Models used to research loom weights have to be based on loom weights from sites with great numbers of weights, so conclusions can be drawn from the averages.
In some cases woven cloth can reveal whether it was woven on a warp-weighted loom. The separately woven starting border is a typical distinguishing feature of cloth woven on a warp-weighted loom (Crowfoot 1951:18, fig. 3 and plate VII: 21; Hoffmann 1974:151-152,154 and 178; Hald 1980:203, 205-208; Browning 1988:29; Raeder Knudsen 1998: 79-84; Raeder Knudsen 2010; Cecchini 2000:211). Such a distinguishing border has been found at Kuntillet Ajrud (Sheffer and Tidhar 1991: 4-5).

The average size of the warp-weighted loom
So what was the average size of a warp-weighted loom? This question has been answered in many ways. According to Hoffman, complete looms consisted of at least 10 weights up to a maximum of about 100 loom weights. In Scandinavia the warp-weighted loom consists of 13 to 59 weights per loom (Hoffmann 1974:24-57). Barber (1991:104) concludes that sets of 6-30 loom weights were used on the looms that have been excavated and found in situ and registered as such in her research. The numbers of loom weights used on a warp-weighted loom vary dramatically depending on their weight and diameter, and there are variations over the different periods and countries. Only securely registered finds can give an answer to this question.
From experiments (Shamir 1996 and Sheffer 1981) we know that a certain maximum number of threads can be tied to a weight, because bunches of warp threads bound together on a loom weight would disrupt the warp in such a way that holes would appear in the textile. The average number of loom weights used on the warp-weighted loom in the Iron Age in the Levant is about 10-50 weights. Generally 30 weights are thought to be a complete loom Elgavish (1968:33). Shamir used 22 weights in her experiment, with 4 threads to each loom weight (Shamir 1996:144).

Setting up a warp-weighted loom using fewer than 10 loom weights would not be useful because warping such a loom takes a lot of time, and weaving such narrow pieces of cloth would be better made on a different type of loom. Narrow woven bands can for instance be produced on a back-strap loom or with a set of tablets to produce a patterned piece of cloth, for use as a belt or a band. The warp-weighted loom occupies much more space than the back-strap loom or a set of tablet weaving cards made of wood or bone.
To conclude, complete sets of loom weights are found ranging from 10 weights up to a maximum of about 100 loom weights, depending on the form and weight of the loom weights, which in turn is dependent on the period when the loom was used. From the average size of the loom we can conclude the width of the cloth produced on that specific loom, and that is interesting for production estimations.

The textiles found in Kuntillet Ajrud can serve as a reference collection for Iron Age textiles in the southern Levant. These textiles have a density of between 10 and 20 threads per 1 cm, using wool and linen (Sheffer and Tidhar 1991). Experiments by non-professional weavers have shown a density of 5 threads per 1 cm using wool,. The fragment of hempen cloth from Deir Alla has 10 threads per 1 cm (Chapter 6). Taking 15 warp threads for each loom weight, and with an average loom of 22.2 loom weights, this results in (22.2x15=) 333 warp threads using wool. Using linen that could be 20 warp threads for each loom weight, making (22.2x20=) 444 warp threads. The average width of the wool cloth made in Deir Alla was (333:10=) 33.3 cm wide and linen and hemp might have been (444:10=) 44.4 cm wide. The largest group of loom weights at Deir Alla numbers 52 loom weights, making the width of the cloth woven if wool was used on this loom 78.0 cm, and if hemp or linen was used the cloth would have been 104 cm wide. Based on the loom weights within the large groups, the width of woven textile made in Deir Alla was 53.4 cm wide on average.

11.7 Reconstruction of textile production in Iron Age Transjordan

Whether the Central Jordan Valley, dominated by Tell Mazar, Tell Deir Alla and Tell es-Saidiyeh (map 6.1), was part of the Ammonite kingdom is a matter of debate. Biblical tradition suggests Ammon became a kingdom before the 10th century, but there are no external textual or archaeological sources supporting this. It has been suggested that large tribal confederations were in control of the region and over time developed into tribal kingdoms (Yassine and Van der Steen 2012:2; Van der Steen and Smelik 2007; Younker 1999:208-209). Herr (1992:175) defines the Ammonites in Iron Age II as a well-defined ethnic or cultural group extending into the Jordan Valley as far as Tell Mazar, and possibly Tell es-Saidiyeh, but absent in Pella.
The small tribal kingdoms of Ammon, Moab, Edom, Israel and Judah were overrun by the Neo-Assyrians, Neo-Babylonian and Persian empires from the North, who used the Jordan Valley as a pathway to the south (Yassine and Van der Steen 2012:2). Neo-Assyrian influence can be found in the material culture of Tell Deir Alla, Tell Mazar, Tell Adliyeh, Tell es-Saidiyeh and Tell Damiyah. Tell Damiyah was a Neo-Assyrian centre situated strategically on an east-west crossroads on the river Jordan (Petit 2009:187, 226).

After the Babylonian conquest the political map of the region did not change significantly – the incorporation of Ammon into the Neo-Babylonian empire coincided with a decline in the settled population, but the large sites in the Jordan Valley, Deir Alla, Mazar and Saidiyeh, remained settled together with some smaller sites (Yassine and Van der Steen 2012:2). In the Persian Period the settlement pattern in the Central Jordan Valley did not change and Deir Alla, Mazar and Saidiyeh remained settled and of importance within the region.

Reconstructions

Studies of loom weights can be boring subject for those not familiar with weaving, and for archaeologists who dislike these ugly, damaged and puzzling loom weights. To come nearer to the people who produced the textiles, and to demonstrate what can be hidden behind these loom

weights, I made four reconstructions, three of which are situated in the Central Jordan Valley. Tell Deir Alla, Tell Mazar and Tell es Saidiyeh were sister sites, their function seems to have a direct connection and their fates were also often connected. In the Iron Age layers of these sites so near each other, many loom weights have been found pointing to an elaborate textile production situation.
The first reconstruction is based on the loom weights and the cloth found in Tell Deir Alla phase IX, and demonstrates what kind of textiles were produced in the households involved in weaving and what the consequences could have been. The second is based on the loom weights from the different strata of Tell Mazar; it gives some indications about whether patterned textiles were woven and how much the weaving output might have been. The third reconstruction is based on literature about the finds from Tell es-Saidiyeh Stratum V that can be categorized as an industrial quarter. The fourth is based on the material from Khirbet al-Mudayna in Moab, spindle whorls, loom weights and textile finds serve the reconstruction and give some indications about the quantities of yarn and cloth produced at the site.

The use of loom weights

The warp threads were not tied directly through the holes of the loom weight, rather a loop was threaded through the hole of the weight and then a bunch of warp threads was tied to the loop. Experiments have shown that an average number of 15 warp threads were tied to each loom weight, using wool; linen is thinner and so 20 threads could have been used. These numbers make weaving possible without disrupting the warp in such a way that holes would appear in the textile. In my reconstructions I used the fictive number of 10 loom weights as the absolute bottom line to represent a loom. The upper limits are taken from the excavated and registered loom weights. In Deir Alla phase IX the average set of loom weights is 28 per loom. Khirbet al-Mudayna yielded 29 loom weights on average per loom. Tell Mazar Strata V, III and II resulted in 23 loom weights on average per loom. This resulted in an average of 27 loom weights per loom in Iron Age Transjordan.

Reconstruction of textile production at Tell Deir Alla phase IX

Tell Deir Alla phase IX yielded three times more loom weights than most Iron Age sites in the Levant. At the moment of destruction of the village by an earthquake, at least 675 loom weights were present in the houses, on the roofs and in the courtyards. In Deir Alla at least 24 looms were in operation in the settlement. According to Van der Kooij and Ibrahim, the excavated part of the village was inhabited by fifteen households (1989:86-87). Thus the conclusion must be that more than one warp-weighted loom was used per household. It is possible that other techniques to make cloth were used as well, no archaeological traces of which have survived, such as weaving on a horizontal loom or card-weaving, which would make the amount of textile produced in the village even larger.

The loom weights of Deir Alla were found in 15 (possibly 16[116]) different groups, and each group represents a loom. From these groups the following could be concluded.
The position in which the loom weights were found indicates the kind of textiles produced (see Chapter 2.3). One of the looms consisted of two rows of loom weights, which points to production of cloth in tabby weave. Five groups consisted of 3 rows of loom weights indicating that a 2/1 twill weave was produced on these looms. Two looms consisted of four rows of loom weights pointing to the production of 2/2 twill woven cloth. The loom weights of four of the looms were not found in a position revealing their original position on the loom. Three groups of weights were found scattered in the roof debris of the buildings on which they originally stood and one set of weights was found in storage.

It can be concluded that at Deir Alla some cloth was woven in tabby weave, but the majority of the weavers were making patterned textiles, such as uneven and even twills (Chapters 2.3 and

[116] See group 14 in Chapter 6.4.

3.3). The finds demonstrate that different kinds of fine and patterned (hempen) cloth were woven within the village. The people of Tell Deir Alla phase IX produced textiles in a professional way, and they invested a lot of time in weaving on the looms, producing large quantities of specialized textiles. Having more than one loom in the different households indicates that the amount of textiles produced in the village was too much for their own use; it is likely that they were involved in selling the surplus.

Production of the special fine hempen cloth possibly strengthened the position of this small village within this network. Considering the location of the benched room with a religious text written on the wall (the Balaam inscription) in the middle of the village, the production of textiles may also have been associated with a cultic use (see further Chapter 12).

Reconstruction of textile production in the different strata of Tell Mazar

No textile items have been found at Tell Mazar. Since the fineness of the yarn used to weave these items is thus unknown, it is only possible to estimate tentatively what the textile production output at Mazar might have been.

Simply imagining a transparent veil weighing less than 50 g, or patterned drapes of about 500 g, or a nicely patterned cushion cover to sit on weighing about 100 g does not enable us to count the number of items produced at Mazar. However, the total weight of what could have been produced does give an interesting indication of textile production at Mazar. From Neo-Babylonian texts it can be deduced that an individual weaver at home could produce at least 2.5 kg of wool fabric in 6 months (Joannès 2010:404). When applying these figures to Tell Mazar a slight idea can be gained of the textiles produced, although we do not know whether these amounts were realized with linen and/or hemp. We can differentiate between patterned and non-patterned cloth because the position in which the loom weights of one of the looms were found is known, revealing four rows of weights, suggesting that a 2/2 twill weave was made. In Stratum II one small group of eleven loom weights was found in storage (see Chapter 7 group 9). Another group of loom weights (Chapter 7 group 12) is more diverse in shape, suggesting that a special kind of cloth was woven because the diverse thicknesses of the weights would result in differences in the spaces between the warp threads, thus in a more open gauze-like weft.

The word *fabrics* will be used here when the position of the loom weights was not documented and thus it cannot be ascertained whether the cloth was patterned or not.

The choice of weaving technique is determined by the functional purpose of the fabric. A dense and coarse twill fabric can be used for an outer garment, and will protect the wearer from wind and cold. A finer twill and tabby would be functional for different types of inner garments and as protection from sun and heat, while an open tabby weave could be used as a veil. When interpreting the use of textiles it is important to realize that the choice of weaving technique is due to several factors, such as availability of raw materials, tradition and socioeconomic factors.

Stratum V Iron Age IIB/C 8th -7th century BC	Stratum III Iron Age IIC 7th - 6th century BC	Stratum II Persian Period 5th- 4th century BC	Stratum I Early Hellenistic Period, 4th century BC
1 loom with 4 rows of loom weights	7 looms with unknown rows of loom weights	1 small group of loom weights was in storage 1 loom to make a special kind of gauze-like cloth 3 looms with unknown rows of loom weights	3 looms with unknown rows of loom weights,
5 kg of patterned cloth, possibly a 2.2 twill weave	35 kg of fabric	15 kg of fabric, 5 kg of open gauze-like cloth storage = capacity to produce 5 kg more fabrics	15 kg of fabric

Table.11.8. Textile output in the different strata of Tell Mazar.

Reconstruction of textile production at Tell es-Saidiyeh Stratum V

The architectural structure of Tell es-Saidiyeh is very surprising and the finds are similar to the finds from Deir Alla.

Tell es-Saidiyeh is situated in the Jordan Valley about 10 km to the northwest of Tell Mazar (Pal. Grid 204.186 EE IV 1028). The site was excavated by Pritchard in 1964 and 1967 and reinvestigated by J. Tubb. Pritchard (1985) published the plan (fig. 11.5) and the finds of Stratum V. The loom weights were found within the architectural units, enabling a brief reconstruction and interpretation of Stratum V. The structures yielded hundreds of donut-shaped clay loom weights found in situ within the buildings, together with storage vessels, grinding stones and ovens, but no spindle whorls have been recorded. Stratum V (fig. 11.5) was a fortified settlement; the standard architectural unit consisted of a main room with a smaller room behind the front room. The six identical units were built in a line with shared sidewalls, their entrances facing a street running north-south. The back wall of these buildings was shared by a parallel set of units built directly behind the first set of six. The second set of units was a mirror image of the buildings across the street. Pritchard interpreted the structures as domestic houses with lots of loom weights.

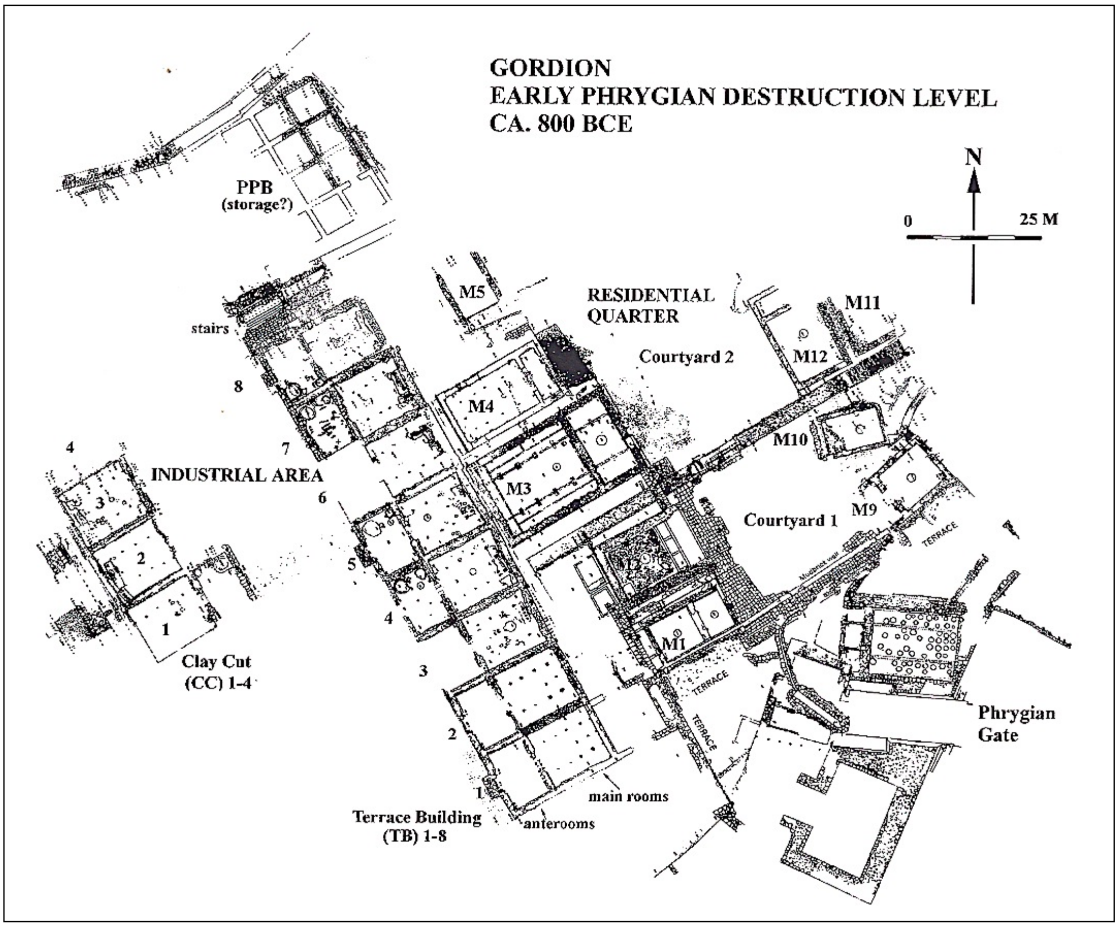

Fig. 11.6. Gordion industrial quarter (Burke 2010:fig 5. Courtesy of B.Burke).

According to Burke (2010:166-167), however, who studied the structures and finds of Gordion, the plan of Tell es-Saidiyeh Stratum V shows a group of building units that are very similar to the structures found at contemporaneous Gordion in Anatolia (fig. 11.6), implying specialized industrial workshops.

Burke (2010) has rightly interpreted the organized building plan of Tell es-Saidiyeh with the finds as an industrial quarter. Many Iron Age II towns have yielded quarters where craftsmen were concentrated, such as in Syria (Qatna) and at Tel Batash (Timnah) in Israel. In Qatna an artisan's quarter has been excavated specializing in the production of textiles and dyeing, and a workshop for metallurgy and pottery production (Morandi Bonacossi 2006). In Timnah an industrial and commercial quarter (H) was recovered where olive oil was produced, while a residential / industrial quarter (F) showed evidence for the production and selling of olive oil and textiles (Kelm and Mazar 1995:16-17). The situation in Saidiyeh is a striking example of an industrial quarter where textiles were produced within identical buildings lined along a street in one of the quarters of the settlement specializing in the craft of textile production.

Fig. 11.5. Plan of Tell es-Saidiyeh Stratum V (Pritchard 1985, fig. 179).

Reconstruction of textile production at Khirbet al-Mudayna in Moab

Five looms could be estimated (155 loom weights) from the loom weights of Khirbet al-Mudayna, the remaining 95 loom weights were scattered over the settlement. The 250 loom weights from Khirbet al-Mudayna are not very heavy; their average weight is 269 g, suggesting that mainly wool was woven at the site. The results from the spindle whorls suggest that the spun wool to be woven on the warp-weighted looms was brought from outside the settlement.

When applying some general figures to the material of Tell Khirbet al-Mudayna an idea can be given of the amount of textile produced. The 250 loom weights of Mudayna can represent no more than 8.3 looms. According to Anderson Strand (2010:12) a maximum of 1.25 kg (ewe) or 2.5 kg (whether) from a fleece can be used for spinning. From Neo-Babylonian texts it can be deduced that an individual weaver at home could produce 2.5 kg of wool fabric in 6 months (Joannès 2010:404). Applying the amount of wool fabric as recorded in the Neo-Babylonian texts to the situation in Khirbet al-Mudayna the outcome is as follows: If eight looms were in use for weaving, 20 kg of woollen cloth could be produced in six months. If the weaving was performed all year round, 40 kg of woollen cloth could be produced in a year. Producing 40 kg of woollen textile requires the wool of about 75 sheep.

In my research I did not focus on spinning and the production of yarn. Nevertheless the spindle whorls from Khirbet al-Mudayna revealed some interesting facts about spinning. I did not study the artefacts themselves but the descriptions from the artefact lists (1996-2009), kindly supplied by the excavator Michelle Daviau. To investigate whether the yarn used in weaving could have been produced at the site, I analyzed the weight and number of spindle whorls from Mudayna in comparison to the loom weights. Barber estimates that it would take seven to eight hours to spin the thread that could be woven in approximately one hour (Barber 1997:515); if the thread used on the looms was produced at the site then far more whorls than loom weights would be expected (Burke 2010:50). However, this situation can never be fact, not even in the situation at Gordion described by Burke. Some other criteria are needed to interpret the number of spindle whorls. Spindle whorls are light and can easily be taken outside; spindle whorls are also regarded as a personal belonging, found in burials from the Early Bronze Age till the Iron Age periods at different sites in Anatolia, Cyprus, Syria (Barber 1991:60-62, 63), and Megiddo (Guy 1938:170), therefore they will not always be found in public places or in storage together with the heavy loom weights.

In order to give an indication of the number of spindle whorls used in different circumstances, some comparative figures will be presented here. It has been estimated that 2-4 spindle whorls were used in a household (Levy 2006:716). But in Mudayna spinning took place in the public space, and therefore other figures are needed for the comparison. In Gordion in about 800 BC, large-scale production of textiles has been attested. The loom weights are mainly donut-shaped, comparable to those at Khirbet al-Mudayna, though the loom weights from Gordion are heavier ranging between 400 and 700 g. The textile equipment was found together with food processing installations and large quantities of pottery in 8 different production rooms, situated next to each other (fig. 11.6). From the figures of the Terrace Complex, which can be regarded as a textile production centre (Burke 2010:108-150), the ratio between loom weights and spindle whorls is about 55 spindle whorls to 250 loom weights.[117] When comparing the number of excavated spindle whorls from Mudayna with these data, the number of spindle whorls compared to the number of loom weights is low.

The weight of spindle whorls

According to Burke, who studied over 1000 spindle whorls from the industrial quarter of Gordion, spindle whorls can be divided into three groups. The whorls range from 5 g to 80 g, with an average weight of 24 g. Most of the spindle whorls from Gordion are light spindle whorls, ranging from beadlike ones to ones weighing 20 g (Burke 2010:114-115, 124-145).

Only one of the textile fragments recovered from Khirbet al-Mudayna (Chapter 8) was made of wool, the others were made of linen, some of which were used in basketry. These textiles do not reveal much about the cloth that was made at the site. However, the spindle whorls and loom weights do indicate what and how much was produced at the site.

Light spindle whorls	**Medium spindle whorls**	**Heavy spindle whorls**
0-10 g	30-40 g	60-70 g
10-20 g	40-50 g	70-80 g
20-30 g	50-60 g	80-90 g

Table 11.9. Groups of spindle whorls from Gordion according to Burke (2010:127-144).

[117] Figures from the Gordion Terrace complex (Burke 2010:127-144), Fig. 10.5: Terrace building 1 yielded three spindle whorls no loom weights; Terrace building 2 yielded 77 spindle whorls and 500 loom weights; Terrace building 3 yielded 138 spindle whorls and 500 loom weights; Terrace building 4 yielded 61 spindle whorls and 226 loom weights; Terrace building 5 yielded 44 spindle whorls and 20 loom weights; Terrace building 6 yielded 48 spindle whorls and 25 loom weights; Terrace building 7 yielded 101 spindle whorls and 450 loom weights; Terrace building 8 yielded 92 spindle whorls and about 100 loom weights.

Spinning at Khirbet al-Mudayna (see also Chapter 8.9)
Thirty-three spindle whorls have been found at Khirbet al-Mudayna. The whorls are heavy to medium in weight, and no light whorls weighing 5-40 g have been found. The average weight of a whorl in Mudayna is 80.5 g (ranging from 40-190 g) and the average diameter of the spindle whorls is 4.3 cm while the average diameter of the perforation is 6.2 mm. The weight of the spindle whorls indicates the thickness of the spun yarn: from experiments conducted at the CTR in Copenhagen it is known that the heavier the whorl, the thicker the thread (Andersson Strand 2010:14). Fine wool requires the use of light whorls weighing up to 33 g maximum.

Light 0-40 g	**Medium 40-60 g**	**Heavy 60-90 g**	**Extremely heavy 110-190 g**
0	17 spindle whorls (51.5%)	11 spindle whorls (33,3%)	5 spindle whorls (2%)

Table 11.10. Spindle whorls from Khirbet al-Mudayna N=33.

The spindle whorls at Khirbet al-Mudayna are exceptional; they are large and heavy compared to those of other sites. At Beth-Shean, 23 spindle whorls were found, their weights ranging between 2.28 and 27.75 g (Yahalom-Mack 2007:661-666). Twenty-seven whorls have been published from Kadesh Barnea, with weights ranging between 12.5 and 106.7 g (Shamir 2007:265-267). The City of David excavations in Jerusalem yielded 73 specimens from different strata and periods, their weights ranging from 4 to 97.6 g (Shamir 1996:149-151), while in Iron Age Gordion more than 1000 specimen were studied and published, with an average weight of 28 g, ranging from 5 to 80 g (Burke 2010:108-150).

It has been suggested that the width (diameter) of a whorl is important in combination with the weight because it indicates the moment of inertia, responsible for twisting the yarn (Verhecken 2010) but in the case of Mudayna no meaningful results could be derived. However, it is possible to make a rough guess at whether vegetal or woollen yarn was produced from the shape of the whorl. It has been suggested (Garstang 1953:172-172) that flat spindle whorls were used for spinning wool, while bulbous spindles were used to spin vegetal materials such as flax and hemp. Assuming that the ceramic and reworked sherds are flat while ivory bone and stone spindles tend to be bulbous, the following reconstruction can be made.
Twenty-two (67%) spindle whorls are bulbous and heavy. They were probably used to spin vegetal material. Only 11 spindle whorls (33%) are flat and may have been used to spin wool. These flat whorls are heavy and thus produced a thick woollen thread, possibly to be used as warp on the loom or for weaving a coarse woollen fabric. For an experienced spinner, it is not complicated to spin wool, and it can be done while walking or riding, as can be observed in the Middle East, Greece and Turkey up to the present day. The spinning of flax or hemp is technically more complicated because spinning the coarse vegetal products requires skilled hands, a distaff to hold the fibre, and some moisture in the form of water or saliva. It therefore will not be performed while walking or riding but rather inside the village. The heavy bulbous spindle whorls found in Mudayna were probably used to produce the thick linen yarns found at the site. Fragments of linen yarn were found inside pottery fragments and linen yarn was also found in the remnants of coiled basketry plaited with linen thread (Chapter 8.2). It is also possible that the heavy spindle whorls were used to spin thick woollen yarn for coarse fabrics or thick threads to be used as warp threads. Fine wool, such as the threads used in the cloth fragment found at the site (see Chapter 8.2), was not spun in Mudayna because light whorls weighing no more than 33 g are required for such yarn. Only a small amount of thick vegetal thread and/or thick woollen yarn could be produced with the limited number of spindle whorls found at Khirbet al-Mudayna. Further interpretations of the finds and the textiles produced at Khirbet al-Mudayna are discussed in Chapter 12.

11. 8 Conclusions

The finds from Tell er-Rumeith point to limited domestic production. Deir Alla and Tell es-Saidiyeh, with their huge and concentrated numbers of Iron Age loom weights and distinctive architecture, indicate production for others than the direct inhabitants, suggesting specialization and trade. Tell es-Saidiyeh Stratum V can be regarded as an example of planned architecture designed for large-scale textile production. Tell Mazar strata V and III (Iron Age) indicate the production of diverse kinds of textiles. Tell Mazar Stratum II (Persian Period) indicates concentrated production of textiles, but the figures for Tell Mazar are too low to interpret production within the social context of the site and its environment.

At Khirbet al-Mudayna, thus far all the finds associated with textile production have been found within public structures, suggesting that textiles were made for communal demands. What kind of communal interest there was in producing small amounts of cloth, and spinning yarn on very small scale combined with dyeing textiles, can only be assumed and will be discussed in Chapter 12. A thorough study of the different public buildings equipped with grinding and pounding installations and basins must be undertaken. This study should be combined with a detailed pottery study to find an answer to the question about the function of the public buildings at Mudayna. To reveal the function of Mudayna, the unexcavated central part of the fort should be studied by means of trenches or resistivity techniques in order to discover whether there was a domestic quarter within the casemate walls. If domestic structures are ever found at Mudayna, it will be important to compare the material from the public buildings to domestic finds associated with textile production.

The artefacts used in textile production found at sites in Transjordan demonstrate that textile production was performed in nucleated workshops aggregated within the community. This means that textiles were produced in workshops formed around a central area supplying the total demand for textiles.

Chapter 12 Textiles and cult

In this chapter a possible relationship between textile production and cult activities will be investigated.[118] There is some evidence that may be relevant: loom weights are often found at Iron Age sites near and within cultic structures, pointing to the possible existence of workshops for the production of fabrics. A relationship between weaving and cult places has been suggested for Ta'anach (Lapp 1964:28), Tel Qasile (Mazar 1985:80), Kuntillet Ajrud (Sheffer and Tidhar 1991:12; 2012:301) and Megaron building 350 at Miqne-Ekron (Gitin 1993:250; Zevit 2001:134-135). I will investigate whether the production of textiles at Khirbet al-Mudayna and Deir Alla could have been related to the cultic structures found at both sites.

At Khirbet al-Mudayna, weaving and spinning implements as well as dyeing installations have only been found in public areas and not in domestic contexts, demonstrating that production of textiles was probably meant for public use or profit. However, the finds associated with textile production from Khirbet al-Mudayna, studied in Chapter 8 of this book, reveal that only small amounts of textiles were produced. The quantities produced at the site were very small, suggesting some kind of communal use within the enclosure. Production of textiles for public use may indicate a religious connotation, because weaving for a temple and especially weaving clothes for a deity is a well-known phenomenon in the ancient Near East and in the Hebrew Bible as well.[119] In the first section of this chapter I will investigate whether traces of such activities can be found at the Moabite site of Khirbet al-Mudayna in Wadi ath-Thamad.

Some authors suggest a relationship between spinning and weaving and the goddess Asherah. This association is primarily based on two Ugaritic texts and a text from the Hebrew Bible. In the second part of this chapter I will investigate whether finds associated with textile production and texts found at Deir Alla phase IX and Kuntillet Ajrud illustrate this practice.

12.1 Theories and indicators to distinguish cultic elements in archaeology

Distinguishing aspects of cult in the archaeological record is complicated because religious phenomena from the Iron Age are largely unknown. Moreover, for decades the archaeology of the Southern Levant interpreted too many buildings as cultic places, without clear criteria. Nowadays several authors have established basic criteria for identifying 'cult' places in archaeology. These criteria and theories provide a framework for the interpretation of finds. The theoretical framework used here is based on Coogan (1987), Renfrew and Bahn (1991) and Zevit (2001).

Coogan gives four criteria to identify cult in the archaeological record in the absence of written evidence (1987:2-3). Coogan's list is also helpful in cases where the function of written texts is unclear or where the relationships between text and architecture and/or artefacts are opaque.
1. *Isolation*, in most cultures there is a separation between the sacred and the profane. 2. *Exotic materials*, the presence of materials not found in other contexts, such as miniature vessels, figurines, and rare or expensive objects. If personnel, on a regular basis, served the cultic site, domestic materials such as cooking pots will also occur. 3. *Continuity*, which applies only to multi-period sites. 4. *Parallels*, given human conservatism, similar functions will entail similar forms, especially when they are contemporary. Thus building plans, altars, pedestals and the like should bear a resemblance to cultic installations known from other sources.

Renfrew and Bahn have also suggested archaeological indicators of cult (1991:358-363). The archaeology of cult can be defined as a system of patterned actions in response to religious beliefs. A complication is that these actions are not always clearly separated from other actions in

[118] A cult is a system of religious veneration and devotion directed towards a particular figure or object.
[119] Note the skills needed for the fabrication of the Tent of Meeting (Exod.35:25-26, 35).

everyday life and are thus difficult to distinguish archaeologically. When distinguishing cult from other activities, it is important not to lose sight of the transcendent object of the cult activity.

Archaeological indicators of cult according to Renfrew and Bahn (1991:358-363):

"A. Focusing of attention:
1. Ritual may take place in a location with special natural associations (such as a cave, grove of trees, spring or mountaintop).
2. Alternatively, ritual may take place in a special building set apart for sacred functions (such as temples and churches)
3. The structure and equipment used for ritual may employ attention-focusing devices, reflected in the architecture, special fixtures (such as altars, benches and hearths), and in the movable equipment (such as lamps, gongs and bells, ritual vessels, censers, altar cloths).
4. The sacred area is likely to be rich in repetitive symbols (this is known as redundancy).

B. Boundary zone between this world and the next:
1. Ritual may involve both conspicuous public display (and expenditure) and hidden exclusive mysteries, whose practice will be reflected in the architecture.
2. Concepts of cleanliness and pollution may be reflected in the facilities (such as pools or basins) and maintenance of the sacred area.

C. Presence of the deity:
1. The association with a deity or deities may be reflected in the use of cult images, or representations of the deity in abstract form. Animal symbolism (of real or mythical animals) may be used with particular animals relating to specific deities or powers.
2. The ritualistic symbols will often relate iconographically to the deities worshipped and their associated myths.
3. The ritualistic symbols may relate to those seen also in funerary ritual and in other rites of passage.

D. Participation and offering:
1. Worship will involve prayer and special movements - gestures of adoration - and these may be reflected in the art or iconography of decorations or images.
2. The ritual may employ various devices for inducing religious experience (such as dance, music, drugs, and the infliction of pain).
3. The sacrifice of animals or humans may be practised.
4. Food and drink may be brought and possibly consumed as offerings or burned/poured away.
5. All kinds of material objects may be brought and offered (votives). The act of offering may entail breakage and hiding or discard.
6. Great investment of wealth may be reflected both in the equipment used and in the offerings made.
7. Great investment of wealth and resources may be reflected in the structure itself and in facilities."

In practice only a few of these criteria will be found in any specific archaeological context." (Renfrew and Bahn 1991:360).

Zevit (2001:123-124) designed a set of terms based on technical criteria to distinguish between data (the excavated structures) and their interpretation. Zevit differentiates between cultic structures by size, and their public or domestic function in nine categories, ranging from cult place to cult site.[120]

Filling out the theoretical framework

Iron Age textual material from the region under study is few and fragmentary, nevertheless it is of great value when reconstructing the social, economic and religious aspects of Iron Age society. To distinguish cultic elements in the archaeological record of the Levantine Iron Age, studying the inscriptions and motifs in context with architecture and artefacts is indispensable.

Texts and motifs. Contemporaneous texts and artistic motifs provide an iconography in which individual deities can be distinguished and recognized.

Architecture. Interregional studies of characteristic architectural elements can provide information supporting the general picture of cultic behaviour within a specific region and culture.

Artefacts. A realistic view of archaeological artefacts is vital for the interpretation of their function and meaning. In this respect it is important to be able to reconstruct how these artefacts were made and used. In this field experiments are of great value, forcing scholars to think realistically and reconstruct a possible past. Detailed study of explicit artefacts can open up new insights on the use and meaning of the artefacts and the structures in which they were found, leading to renewed interpretations of the total archaeological record including cult and aspects of religion.

12. 2 Temple, text and textile production at Khirbet al-Mudayna in Moab

At Khirbet al-Mudayna, a total of 278 loom weights was registered of which 250 could be studied. The 250 loom weights indicate that 8 looms at the most could have been operated at the site. The spindle whorls found at Mudayna are limited in number (33 whorls); the reason might be that some spindle whorls were made of wood. The type and weight of the whorls was restricted to producing linen or coarse wool yarn. The finds associated with textile production from Khirbet al-Mudayna, studied in Chapter 8 of this book, demonstrate that only small amounts of textile were produced. Because weaving and spinning implements as well as dyeing installations have only been found in public areas and not in domestic contexts, production of textiles at Khirbet al-Mudayna was probably meant for public use or profit.[121] The location of the site and the communal activities performed within the public buildings suggests that textiles were sold to the local population (living outside the enclosure), or to traders passing by Mudayna on the north-south route. However, because of the very limited production capacity it is more likely that yarn was spun and textile was woven and probably dyed at the site to be used within the fortification of Mudayna.

[120] Zevit's nine categories: 1. *Cult place*: the place where a cultic act took place. 2. *Cult room*: a room designed for cultic purposes. Situated within a domestic or a public building, or attached to such a building. 3. *Cult corner*: part of a room or courtyard that has been designated for cultic purposes. Cult rooms were built specifically for cultic practices and have their own entrances; cult corners are secondary appropriations of particular spaces. 4. *Cult cave*: a natural or man-made cave where cultic acts were performed, but excluding tombs used for burials where funerary and related rituals were performed. 5. *Cult complex*: a large cult place comprised of more than one structure, but one that does not contain within it any central building. 6. *Cult centre*: a large cult place comprised of more than one structure that contains a central building for which the term *temple* seems inappropriate. *Temple*: a (large) single-room or multi-roomed structure with adjacent or internal open spaces used for cultic purposes. 7. *Temple complex*: a combination of temples and cult rooms (including storage and administrative buildings, such as treasuries and archives). 8. *Shrines*: closet-like, freestanding structures housing images or symbols of a deity. 9. *Cult site*: a place where cultic acts took place (*cult place*), with at least a room designed for cultic purposes in a domestic or a public building, or attached to such a building (*cult room*) (Zevit 2001:123-124).

[121] If domestic structures are found in the as yet unexcavated areas of Mudayna, finds associated with textile production from such areas should be studied separately from the artefacts discussed here and a new general picture of textile production at Khirbet al-Mudayna should be drawn.

Architecture and finds

Khirbet al-Mudayna is an Iron Age site in the Wadi ath-Thamad, on the northern border of ancient Moab in Jordan. It was a fortified compound measuring 140x80 m with casemate walls. The building of the walled settlement has provisionally been dated to the end of the 9th century BC and habitation ended when Khirbet al-Mudayna was attacked and burnt at the end of the 7th or in the 6th century BC (Chadwick, Daviau and Steiner 2000:261). A huge six-chambered gate with two towers, comparable to those found at Megiddo, Hazor and Gezer, protected the northern entrance to the settlement (fig. 12.1). Behind the gate there is an open plaza and a broad road leading into the settlement. To the east of the plaza is building 149, designated as a temple by the excavator. The temple was identified as such because of the architecture and the finds (Daviau and Steiner 2000:1, 18-19). In the following chapter I will argue that the temple is part of a larger unit that can be identified as a temple complex in line with Zevit's criteria.

Coogan's criterion regarding exotic materials (Coogan (1987:2) is met by the presence of materials not found in other contexts, such as 'Cypro-Phoenician' juglets (personal communication Daviau and Steiner; lectures Steiner 2008 and 2010[122]), eight miniature altars from different find spots including the upper floor of the gate complex and the temple complex (Daviau 2002:139), miniature vessels, and decorated basins (see below and Chapter 8).

Using the indicators of Renfrew and Bahn (1991:358-363), it can be assumed that many aspects are applicable to the temple of Khirbet al-Mudayna. Building 149 is a special building set apart for sacred functions. The structure and equipment of the building demonstrate attention-focusing devices, visible in the architecture of the building as benches, a podium and different altars. Ritualistic symbols are found in the inscriptions and motifs on different altars found within the complex. Participation and offering are met by the libation and firing altars and in the inscription on incense altar MT394. Great investment of wealth and resources is reflected in the structure itself and in the facilities at the site. To the south of the temple complex on the east side of the road is a cistern and two pillared buildings. The entrances to the different buildings associated with the temple and the pillared buildings are alongside the road.

[122] ICAANE6 2008 and ISHAJ 2010. M.L. Steiner. The Case of the Enigmatic Cypro-Phoenician Juglets.

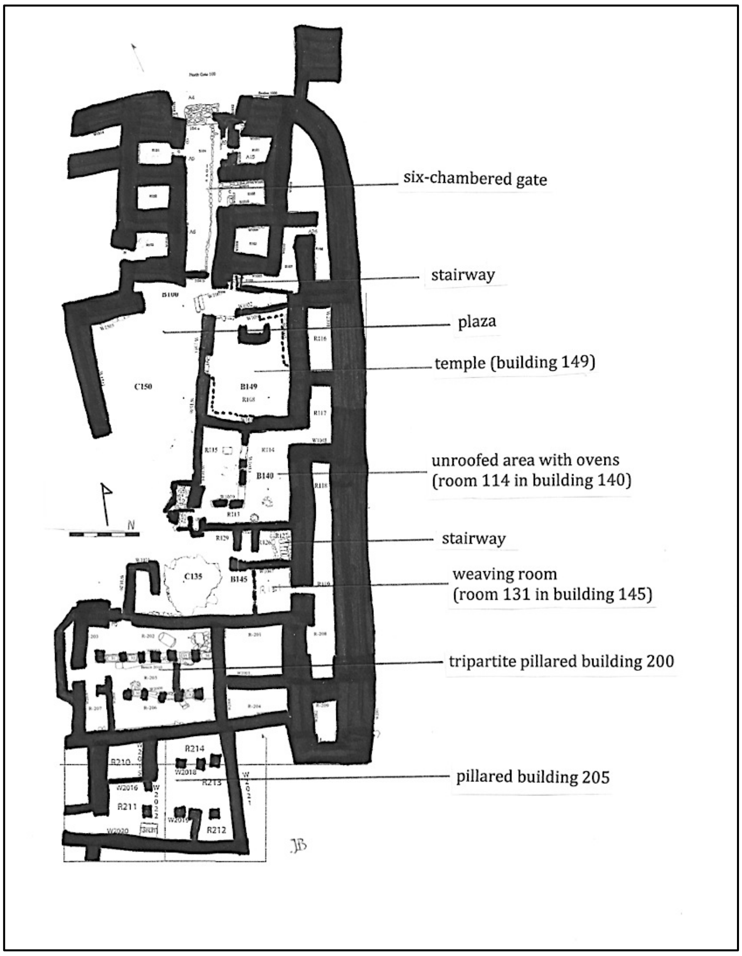

Fig. 12.1. Khirbet al-Mudayna overview (Area A and B). No complete plan was available of Khirbet al-Mudayna, to remedy this situation a compilation drawing of different plans was created by the author; after Daviau and Steiner2000:3; Chadwick, Daviau and Steiner 2000:259; Daviau and Dion 2002:34; Weigl 2006:259.

The northern gate complex

The northern gate complex consisted of an open area in front of the gate, a six-chambered gate with stairs leading to the upper floor and benches alongside the inner walls of the entrance. In the gate were six rooms each with an upper storey. The twelve rooms were used to store several artefacts. Several loom weights were found in the upper rooms of the western gate chambers R151, R152 and R153 (fig. 8.27). The charred remains of a woven mat were found scattered across the floor of room 152 (Chadwick, Daviau and Steiner 2000: 260-261, fig. 3). In the southeastern room (103), a large decorated limestone basin was found. To the north of the gate area, a large loom weight was found together with a cloth-wrapped substance (see Chapter 8.2 figs. 8.42 and 8.43).

Decorated limestone basin

The basin found in the gate area in room R103 is rather spectacular. It is a large rectangular limestone basin, 1.60 m by 0.70 m, which had probably fallen down from the first floor (Chadwick, Daviau and Steiner 2000:260). Three pictures were scratched into the limestone, showing a palm tree (fig. 8.39), an animal with a pattern resembling a loom (fig. 8.38), and two scratched forms that could be interpreted as stylized looms (figs. 8.35-37). This is the only basin with such illustrations known from the Levant. The motifs of the palm tree and the stylized animal seem to fit into the pictorial repertoire known from the Levant. Palm trees symbolize sacred trees and stylized horned animals are interpreted as ibexes (Dothan 1982:752; Keel and Uehlinger1998:39-40; Yasur Landau 2008:224).

The drawings of the 'looms' are very primitive and can perhaps be interpreted as a schematic representation of looms. Figures 8.35-8.37 look a bit like a warp-weighted loom, while the motif in fig. 8.38 below the animal shows a kind of woven band or perhaps a horizontal loom seen from above. These motifs are unique for the Levant. The scratching technique, on the other hand, is comparable to the texts and figures from the tombs at Khirbet Beit Lei (Zevit 2001:figs. 5.11, 5.12, 5.15-5.18, 5.21-5.32).

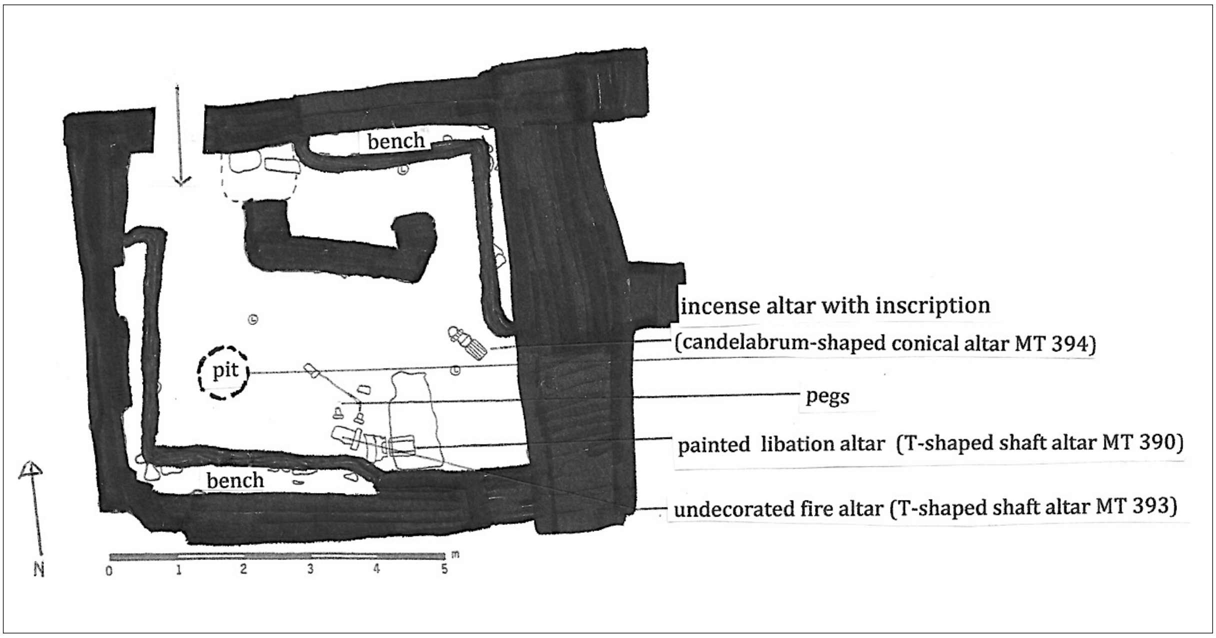

Fig. 12.2. The temple (building 149) indicating where the different artefacts were found. (After Daviau and Steiner 2000:7, fig. 6).

The temple (building 149)

The sanctuary at Khirbet al-Mudayna measures 5.50x5.50 m and is divided by a freestanding bench into a main room and an annex at the northeastern side of the room (fig. 12.2). The freestanding bench was plastered, as were the benches running alongside the walls of the building. Two pillars stood in the room "…acting as ceiling support as well as forming the frame of a doorway." (Daviau and Steiner 2000:5). The temple could be entered from the northwestern side of the building from an alleyway running alongside the gate complex. In the main area was a pit "… clearly in use during the existence of building 149." (Daviau and Steiner 2000:4). Several installations were found in the principal room.[123] A large, smoothly polished flat stone formed a small podium in the southeastern corner of the room. Three lime stone altars were found on and around this podium (fig. 12.2): an inscribed incense altar, a decorated libation altar, and an undecorated fire altar (Daviau and Dion 2000; Daviau and Steiner 2000:8-10; Daviau 2002:129-135.

Incense altar MT394

The incense altar (MT394) is well made, and unique in shape. It is 96 cm high, conical (candelabra shaped) and consists of five segments (fig. 12.3). On top is a cup-shaped depression stained with soot. The altar is made of fine limestone, with incised pendants and crosses and painted with a red and black pattern of triangles. One face of the shaft is decorated from top to bottom with diagonal red lines. Some paint is preserved on the petals of the altar's upper cone.

[123] In the northwestern part of the temple, a mortar and a trough were found together with charcoal, animal bones and lumps of iron (smelting slag) and a gaming board. These finds seem to be from the period when Mudayna was attacked and the sanctuary used as a protected area to prepare and repair weapons (Daviau and Steiner 2000:19).

Inscription on incense altar MT394
On the upper cone of the incense altar, next to the pattern, is an inscription published by Dion and Daviau (2000) reading:
mqtr ʾš ʿś ʾlšmʿ |lysp bt ʾwt
- incense altar (fire) made by Elishama for Yoseph/ Yesaph /Yisaph the daughter of Awat -

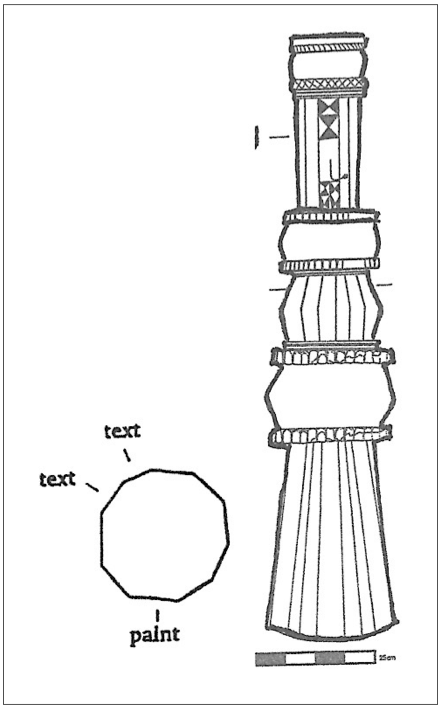

Fig. 12.3. Incense altar MT394 with motifs and inscription (after Daviau 2002:134).

The names used in the inscription are very similar to names from the Hebrew Bible. Elishama is the person who made the altar; he is a professional and talented stonecutter. His name refers to the god EL, the head of the pantheon. Elishama means my god El heard.
Elishama made the altar for *YSPH,* at first sight the name of a man, Joseph (Gen. 37-50). But it is followed by the word *bat,* which means daughter of.... Apparently here YSPH is the name of a woman. Surprisingly the inscription tells us that the altar was made for a woman *J.s.ph* the daughter of...
And here comes a new problem: the name *alef waw taf. Awat* sounds like a feminine form of a name derived from the word *ʿwh,* which means desire. In biblical Hebrew the ending -at is used in a bound form and in a free form.[124] When the name is used in a bound form we expect a deity to follow the ending –at, for instance *Awat Baal* (desired by Baal). But in this inscription there is no word following this name. The altar and the inscription on it are carefully made and there are no signs of an extra word. Thus it is a name used in the free form, meaning *the desired one.* The next question is whether *Awat* was a man or a woman. In the Moabite language the feminine -t is used both in the *status constructus* and in the *status absolutus* (Klaas Smelik, personal communication February 2013). In the Mesha inscription the -t ending is more frequent than the -h ending (Dion and Daviau 2000:9). The second part of the inscription therefore means: Awat (the desired one / name of a woman), the mother of Yoseph/Yisaph.

According to Dion and Daviau (2000:9), the inscription on the altar is not a dedicatory inscription but a label, naming both the maker and the customer. It is comparable to the inscription on a small incense altar from the Persian Period found at Lachish (Dupont-Sommer 1964:108-111; Lemaire

[124] Discussion in Dion and Daviau 2000:9.

1974:67; Aharoni 1975:7; Dion and Daviau 2000:10). There is no dedication to a deity. Can other indications reveal the name of the deity? The drawing found on the altar might provide the key.
On the altar is the drawing of a palm tree; the same motif is also present on the limestone basin excavated in the gate (fig. 8.39). The palm tree is associated with the goddess Asherah (Ackerman 1992:65-66; Dever 2005:203, 225-232). The drawing of the palm tree suggests that the altar was dedicated to a female deity. The incense altar was painted. Only six motifs are left on its upper part (fig. 12.4), each consisting of two triangular shapes in red/brown, arranged in a kind of butterfly pattern. The inscription and the motifs face each other on the upper part of the altar. A person whose personal name referred to the name of the god El made the altar for a Moabite woman. It is remarkable that the altar was made for a woman and that she is identified with her mother's name. Because the father is not mentioned the mother Awat may have been a widow, but it is also possible that she was a woman with special abilities or capacities, an important, influential or powerful person in town.

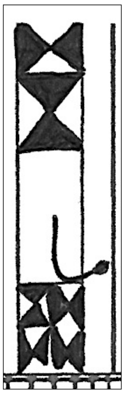

Fig. 12.4. Painted motif on altar MT 394 (after Dion and Daviau 2000:2).

The incense altar is a unique find not only because both the inscription and the painting on the altar reveal some interesting social and religious facts, it is because the incense altar is labelled as such. In the Hebrew bible the word for incense altars, *mqtrwt*, is known from 2Chr. 30:14 where it is used in the plural form (in the inscription on the altar it is used in singular). An incense altar is also mentioned in Exod. 30:1-10. From Ps. 141:2 and Rev. 5:8 and 8:3-4 it is known that the burning of incense could be understood as a form of prayer.

Shaft altars
The other two altars are T-shaped shaft altars and made of limestone.
Painted altar MT 390 (Daviau and Steiner 2000:8-10; Daviau 2002:129-134) is a large altar measuring 33x37 cm in diameter and it is 72-80 cm tall. It can be identified as a libation altar because of the 10 cm deep sump in the central depression of the upper part of the altar (fig. 12.5). The decorations on the altar are geometrical, the upper part of the altar is decorated with a checkered band and the lower part again shows triangular motifs resembling the motifs on the incense altar MT 394.

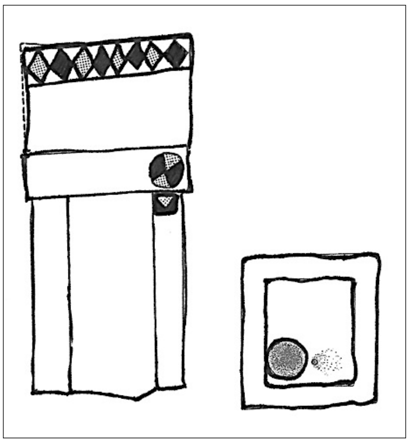

Fig. 12.5. Decorated libation altar MT 390 (after Daviau 2002:134).

The third altar, MT393, is an undecorated T-shaped shaft altar carved from a single block of limestone. It is about 55 cm tall. The top of the altar is rimmed and the sooty depression measures 19.5 x 20.5 cm. The altar has been identified as a fire altar (Daviau 2002:129-130). A band of painted red and black triangles runs around the upper part of the altar. There is a red circle divided into four pie-shaped wedges. A second painted motif shows a red triangle in a black subrectangular form.

Two large limestone mushroom-shaped pegs have been found in the temple. The head of each peg is 10.5-12 cm in diameter and the stems measure 9.5-11 cm. Their exact function is unknown but their association with the altars can be seen from their find spot and the kind of limestone they are made of – it is the same kind of stone as that used for the altars. Other artefacts found within the temple include two shallow bowls, two storage jars, four lamps, two small jugs, a decanter and a white-slipped chalice, a spouted vessel, bronze rings, three ceramic (female) figurines, a limestone ball, a bead, two murex shells and a faience Wadjet eye (Daviau and Steiner 2000:14-15,17-18).

Building 140

Building 140 shared its north wall with Temple 149. It has an unusual layout with a bent entrance, a hallway and several annexes. South of the hall, a staircase led to the upper floor of the building. At the east side of the building were two casemate rooms. The northern part of the building consisted of two north-south rooms separated by a row of piers and lintels. It has been interpreted as a kitchen. Room 114 was a courtyard with two bread ovens and a possible hearth.

Weaving room

Room 131 was situated in the southeast part of building 145, south of building 140. The precise function of building 145 could not be determined exactly, but in the middle of room 131 stood a large warp-weighted loom, consisting of about 50 donut-shaped and spherical loom weights. The position of the loom weights makes clear that four rows of loom weights were used on this loom (Chapter 8.3 fig. 8.21). Warp-weighted looms with two rows of loom weights were used to weave a simple tabby weft (figs. 2.7 and 2.8). Warp-weighted looms consisting of more than two rows of loom weights were used to produce patterned weft. Four rows of loom weights point to the production of a 2/2 twill weft (fig. 2.11). A second group of 15 loom weights in the southeastern corner of the room (fig. 8.22) points to the presence of a second loom; their position cannot be traced back to a specific weaving arrangement. One bone spatula was found in connection with the loom weights.

In Room 131 four fragments of textiles have been excavated. They came from a basket or mat made of reeds, interwoven with linen threads (figs. 8.8-8.12). They were found sitting on top of the loom weights. The basket was made of linen yarn interwoven with reed, resulting in a strong and flexible basket that may have been used to keep yarn ready for weaving on the central loom, or to store some spare loom weights for adjusting the tension of the warp threads of one of the looms. Two pillared buildings, (fig. 12.1), each with large basins and grinding installations used for industrial purposes, possibly textile production (Daviau et al. 2006), were situated to the south of building 145.

The pillared buildings

Building 200 is a rectangular tripartite-pillared building (figs. 12.1 and 8.33). The central space consists of three rooms divided by two parallel rows of limestone pillars and rectangular basins. The floor of the central room (R 206) was plastered with lime, as were the areas around the basins and the pillars. A lot of pottery, pieces of a red mineral, textile fragments, two grinders, a scale weight, and a large limestone basin were found in the roof debris together with many loom weights, indicating that looms may have stood on the roof of this building. On the floor were spindle whorls, astragali, some pottery, a large limestone stopper, some loom weights and a piece of wood. In the debris were two stone worktables, one of which was richly decorated on all sides. More pottery was found in and around the basins that stood between the pillars, as well as loom weights, spatulas[125] and minerals such as haematite and a copper residue. The copper residue was found on an alabaster palette.

The presence of the cistern C135 (fig. 12.1) close to building 200 and the different minerals found in building 200, the pieces of haematite and ochre and the palette with copper residue suggest that these minerals were crushed for use in dyeing. This could have been one of the usual techniques for dyeing cloth or yarn in some kind of liquid, but because of the minerals found it is possible that a different process was used to make coloured cloth, such as painting with minerals (and clay) on cloth to create a *mud cloth*: cloth coloured with mineral pigments using clay as device. Painted mud cloths are known from different parts of Africa. These finds from the pillared buildings suggest that dyeing or making paint might have been part of the activities performed in the pillared buildings.

Astragali

Astragali are the knucklebones of animals. A cache of sheep and goat astragali was found in the northeastern part of pillared building 200, in room 201, together with loom weights, a grinder and textile fragments (Weigl 2006:259). In another room a single astragalus was found together with 22 loom weights.

A cultic or ritual function has often been suggested for astragali. In Tell Ta'anach 140 astragali were found in the cultic structure, together with 58 loom weights, as well as 80 ceramic vessels, several grinding stones, spindle whorls, beads, iron and bronze implements, three small stelae and a mould for a figurine (Lapp 1964:26-32,35-39). The largest sample of astragali from an Iron Age context comes from Megiddo (Stratum VA-IVB). Here, 684 astragali were found together in a deep bowl. Loud has suggested a ritual function for the room in which they were found (Loud 1948:44-46, 161-162, figs. 100-102, plate 285, fig. 388). In Lachish III a smoothed astragalus was found inside a *favissa (*Aharoni 1975:87 plate 30:3-3A), while in the sanctuary of Tel Qasile twenty astragali were found scattered in different rooms (Mazar 1985:150 Table 2). Many astragali have been found at Tell es-Safi: a cache was found near an altar and in some places astragali and loom weights were found together. At this site, two extremely large assemblages of loom weights were found in different cultic contexts (personal communication Debi Cassuto 2013).[126] As astragali and loom weights are often found together, astragali may have been used in

125 Spatulas are thin, pointed tools made of bone, with an oblong and flat shape. They are between 10 and 12 cm in length, 1.5-2 cm wide and 0.1-0.2 cm thick, made of animal ribs, smoothed, with their points showing signs of wear. Most spatulas have one sharply pointed end, but sometimes both ends are sharpened (Cecchini 2000:223). Spatulas were used to pick up some of the warp threads, enabling the weaver to make a pattern in the weft, and therefore they are sometimes called pattern-sticks. Because the warp-weighted loom is very suitable for weaving patterns, spatulas are usually found in association with loom weights (Crowfoot 1941,1944,1945; Tufnell 1953:397; Hoffmann 1974:320), but spatulas can be used on other types of loom as well.

126 Finds of astragali have also been made in contexts not associated with cults. At Tell al-Hammah an unspecified 'large number' of astragali was collected from the western complex of Terrace L (Room 406) (Cahill and Tarler 1993:562). Tell Jawa yielded one astragalus (Daviau 2002:164), which was considered to be a gaming piece. One large knucklebone (4.0 cm long) has been published from Tell Deir Alla (Franken 1992: fig. 4-25:39). In Tel Miqne-Ekron, some forty worked sheep astragali have been found in private and utilitarian contexts (Gilmour 1997:168, fig. 1). At

the weaving process as shuttles to hold the yarn. Since astragali have been found both in and out of religious contexts, no definite conclusions for cultic use can be drawn.

Stone basins
In building 205, south of building 200, no basins were found between the pillars but many freestanding limestone basins were found in this structure. Other finds in this building include pottery, bones, zoomorphic ceramic figurines and other ceramic figurines, a limestone spindle whorl, millstones, basalt grinders, pounders, charcoal, some beads and shells and a loom. Other basins not belonging to architectural constructions were found in pillared buildings 200, 205 and 210. They were made of limestone, are rectangular and about 20-30 cm high, or shallow and circular. It has been suggested that they may have been used for fulling wool (Mazow 2010 and personal communication), although the smell of fulling and dyeing textiles with liquids, which is very pungent and unhealthy, may argue against this. It is possible that the shallow limestone basins and the plastered constructions with basins between pillars inside one of the pillared buildings at Khirbet al-Mudayna were used for dyeing or fulling textiles, or more likely, because of the measurements of these basins, that yarn (not cloth) was dyed there.

Textiles finds from Khirbet al-Mudayna
Some rare fragments of textile have been found at Khirbet al-Mudayna, unique for Moab, while in the wider region, the southern Levant, only the finds from Tell Deir Alla (Chapter 6; Vogelsang-Eastwood 1989; Boertien 2004), Kuntillet Ajrud (Sheffer and Tidhar 1991), and Kadesh Barnea (Shamir 2007) are chronologically close. The textile finds at Khirbet al-Mudayna were not connected to personal use, clothing or furnishing. None of the carbonized textile fragments or the impressions is directly associated with artefacts used for the production of textiles, such as spindle whorls or loom weights.

12.3 Conclusions

The temple of Mudayna revealed a variety of finds, one of the most remarkable being the freestanding limestone altar with the inscription discussed above. The temple complex also had a courtyard with bread ovens and evidence of extensive weaving activity in a room within the temple complex. Architecturally, the temple of Mudayna shows interesting similarities to the benched room at Deir Alla. Both are plastered and benches run along the sides, while a bench divides the room into a main room and an annex. At Deir Alla the benched room (room 335 fig. 12.6) with the Balaam inscription on its western wall measured 3x4.3 m; the northern wall separated the room from a courtyard where bread ovens were situated. To the north of the courtyard, a small complex (rooms 308, 205, 303 and 418) was used for weaving (see further below 12.5).

Weaving at Mudayna was performed not only in the weaving room near the temple but also in and on the roofs of two pillared buildings to the south of the temple complex. The installations in the pillared buildings indicate some kind of industry, perhaps the dyeing of yarn, cloth and hides. The weaving implements, together with the loom weights, demonstrate that weaving took place in and on these public buildings, which points to weaving for communal use. The presence of astragali found together with loom weights in pillared building 205 could have been associated with the weaving activity. Whether cultic use or religious connotation can be considered for the astragali requires further research on the unpublished astragali, stratigraphy and the pottery from building 205.
Sixteen altars were found at Khirbet al-Mudayna. Three altars are from the temple, five medium-sized altars and eight miniature altars were found in industrial buildings or in roof material found on the street or within the pillared buildings. One of the shaft altars MT684, measuring 25.5x23.2

Tell Mardikh-Ebla, 202 worked and unworked astragali (fig. 8.41) were found in several contexts from Early Bronze to Iron Age layers (Minniti and Peyronel 2005:7-26).

cm, was decorated with a lotus blossom; it was found in the roof debris of pillared building 205. The lotus blossom is identified as a symbol of regeneration (Van Loon 1986:247). A palm tree is depicted on the inscribed altar from the temple and on the decorated basin. Other decorations on the basin have been – tentatively – interpreted as looms. According to Keel 1998:41, 46-47), in the ancient Near East the tree was a conventionalized sign for prosperity and blessing, and a symbol for the presence of a divine power. The palm tree is a representation of the fertility goddess. At Mudayna, all altars were found in public areas in the temple, on the main street and in different public industrial areas, such as the courtyard with bread ovens, and in the pillared buildings. At Mudayna, loom weights were found in public space and not in domestic environments: in the weaving room of the temple complex and also in and on the roofs of the pillared buildings, together with the different altars.

The herders and farmers working around Mudayna did not live in Mudayna. Mudayna served as a military outpost, protecting the local roads. It probably served as a local market and as a regional administrative centre as well. The sanctuary served both the local population and traders passing by the site (Popkin 2001). Here, weaving and baking bread was performed in public space serving the needs of the temple. The finds from Khirbet al-Mudayna indicate that worship was performed in the temple and in or on the roofs of public buildings within the walled settlement. Therefore it is tempting to conclude that weaving in public space and the presence of the palm tree motif on the large limestone basin, on which looms were also depicted, together with the palm tree motif on the altar, might have been associated with worship of the goddess Asherah.

Textile production is usually found in domestic circumstances; the loom weights from Mudayna being found in public space are a sign that weaving could also be undertaken as a communal activity. Weaving was performed within the temple complex, but also at other places within the fortification. Obviously weaving and dyeing at Mudayna were associated with different forms of religious practice, because loom weights and indications for dyeing have been found together with different kinds of altars, suggesting a relationship between textile production and religion.
The inscribed altar from the temple demonstrates that women could have an altar made and placed within the temple. Apparently women played a prominent role in religious life and had the economic means to have an altar made by a skilled artisan. The fact that the woman in question was named alongside her mother emphasizes the role and position of women within Moabite society.
The inscription on the altar made it possible to identify the altar as an incense altar. Because it was found with two other altars, clearly recognizable as a fire altar and an altar used for libations, the finds in the temple at Mudayna demonstrate that three kinds of altars, all known from the Hebrew Bible, were present in the Moabite sanctuary in the Wadi ath-Thamand. The finds from Khirbet Mudayna demonstrate how archaeology adds valuable information in words and images to our understanding of the religion and social structure in the biblical narrative.

12.4 Deir Alla and Kuntillet Ajrud

A relationship between spinning and weaving and the goddess Asherah as suggested by several authors is primarily based on two Ugaritic texts and a text from the Hebrew Bible. In this section I will investigate whether finds associated with textile production and texts found at Deir Alla phase IX and Kuntillet Ajrud illustrate this practice.

According to Ackerman (2003:181), “weaving was a particularly significant activity within Asherah’s cult in the mythology from Late Bronze Age Ugarit, and those who did this weaving had a significant role as cultic functionaries.” In Ugaritic texts, Asherah is described walking on the beach with a spindle in her hand, ‘dropping the spindle from her hand’ (= spinning) (CAT /KTU and UDA 1.4, II 3-11), and she is also associated with weaving in another text (CAT /KTU and UDA 1.4.II 3-4) (Smith 1997:122; Binger 1997:64-71; Dijkstra 2001:114; Korpel 2001:130; Meyers 2003:433).

The Hebrew Bible mentions women weaving garments for Asherah in the Jerusalem temple (2 Kings 23:7). They are described as working in houses (workshops) erected within the temple complex. Such workshops were part of the textile storehouses known as *miltachot*, which existed in royal palaces and temples both in Jerusalem (Jer. 38:11) and in Samaria (2 Kings 10:22). According to Ackerman, this probably means that women wove clothing to be draped over a cult statue dedicated to the goddess Asherah (Ackerman 2003:180).

The archaeological record may illustrate this practice. In Tell Deir Alla and at Kuntillet Ajrud, textiles and loom weights were found within a compound where texts were written and illustrations drawn on plastered walls, and in both cases the inscriptions on the walls and artefacts mention the name of a goddess. A hundred textile fragments were found at Kuntillet Ajrud, and these serve as an important reference collection for the archaeology of textiles. Some of these textiles, as well as the architecture of Kuntillet Ajrud, have inspired interesting theories speaking of the weaving of a special kind of textile for the female deity Asherah. The Balaam inscription, found at Deir Alla, painted on a wall of a small room, speaks of a female deity. Many loom weights have been found in this complex. The excavator Henk Franken has identified the structure as cultic (1999:196-197, 200; 2008:40-44). Comparing the finds from both sites may show whether weaving was performed in a cultic context too. The next question will focus on a special relationship between the production of textiles and a goddess, possibly Asherah.

12.5 Tell Deir Alla phase IX

Tell Deir Alla is located on the crossroads of the north-south trade route and the east-west trade route in the Jordan Valley. It was the last settlement in the Jordan Valley before the road from Beit Shean and Pella to Rabat Ammon led inland, following the river Zerqa (Van der Steen 2004).[127] Phase IX (dated to c. 800 BC) has been interpreted by Van der Kooij (1989) as a village consisting of a conglomerate of some forty small rooms, built tightly together. Franken (2008:41) identified phase IX as a sanctuary, a Baal height, and the surrounding buildings as part of the sanctuary devoted to Balaam.[128] The phase was destroyed by an earthquake and partly by fire, leaving the contents of the rooms largely undisturbed (see further Chapter 6). No fortification has been found surrounding the settlement, and no temple has been identified. A room with benches was found in one of the buildings, which had a text mentioning different deities and a prophet on the plastered western wall, written in red and black ink.

The large number of 675 loom weights was found in phase IX, suggesting that more than thirty warp-weighted looms were in use in the settlement (Chapter 6). Because fifteen households have been identified (Van der Kooij and Ibrahim 1989:86-87), it can be assumed that more than one loom was in use within each household. This suggests that weaving was an important activity in the small village.

A piece of cloth and some fragments of yarn made of a special fibre (hemp) were found in the same complex in which the cult room was found. This raises the question of whether this special kind of cloth could have had a cultic use.

[127] Wenning and Zenger 1991:177 consider Deir Alla to be a trade centre on the crossroads from Beth Shean and Pella to Rabat Ammon and the King's Highway and the route into Cisjordan. Franken (1992; 2008:31) sees Deir Alla as a trade centre on the route south via Damiyah towards Egypt.

[128] Franken 2008:40 stated that after the Late Bronze Age the character of the site remained sacred, Franken writes: 'Gods may be replaced by other gods but the numinous character of the place remains unshaken'.

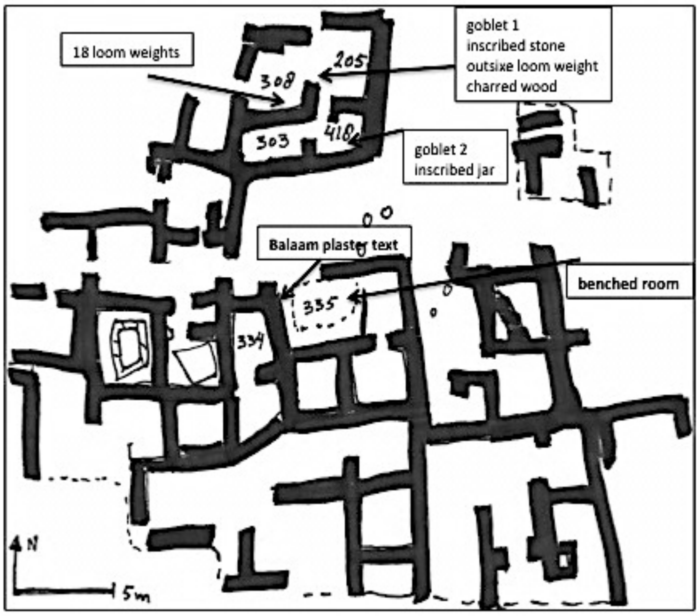

Fig. 12.6. Plan of Deir Alla phase IX, northwestern part of the tell. (Based on the plans published by Franken 1991 plate 16;Van der Kooij and Ibrahim 1989:89, fig. 10;8 and Van der Kooij 2002). [129]

The benched room with the plaster text

The benched room (fig. 12.6 room EE335) measures 3x4.3 m. The floor has been replastered several times. North wall 53 separates the room from a courtyard, where some bread ovens were excavated. A doorway may have been situated in the northwest corner of this wall. About 1 m^2 of inscribed and illustrated wall plaster was found in this room. One concentration of fragments had collapsed and fallen into room EE334, west of the benched room; the other concentration had collapsed into room EE335 itself, the room to which it originally belonged. The text has been reconstructed and published by Hoftijzer and Van der Kooij (1976; 1991 – see also Puech 1985:354-365; 2008:25-48; Dijkstra 1995:47-64; Levine 2003:140-145). The preserved text tells the story of a goddess wanting to destroy mankind, the fragments mention 'Balaam the son of Beor' and describe his visions, prophesies and curses. The stories of Balaam are part of a regional collection of prophetic stories and legends. Stories of Balaam are also recorded in the Hebrew Bible in Numbers 22-24. Noort demonstrates how the image of Balaam was remodeled within the biblical narrative from a positive image in Numbers 22-24 to a negative image in Deut. 23:4, 6; Joshua 24:9-10 and Neh.13:2 and in the description of his death in Numbers 31:16 (Noort 2008:3-23). According to Dijkstra the stories of Balaam were excerpted from a 'Scroll of Balaam son of Beor' (1995:47,64). Puech translates the beginning of the text as follows: "The chastisements of the Book of Balaam, the son of Beor, the man who sees the Gods." (Puech 2008:26). The story about Balaam, on the wall plaster in Deir Alla is a record of prophetic visions with biographical details, which is a characteristic of 'vitae' (Zevit 2001:491 note 44). Figures were sketched to the right and above the text, but only a sphinx-like creature with spread wings has remained almost complete (Van der Kooij and Ibrahim 1989:65, fig. 82). Because of the fragmentary state of the plaster text and the difficulties in combining the fragments, there is no consensus about the reading and translation. The text is linguistically puzzling, although a northern origin / influence is generally accepted (Lipiński 1994:105-159; Blum 2008:573-601).[130]

[129] Because Van de Kooij has published no new plans since 1989 - the plan published in 2002 is the same as the one published in 1989 - the southern part of phase IX cannot be incorporated in this discussion. According to Van der Kooij, the northern block is not a representative sample of the settlement and the southern part (below square B/A7) has much more open space (Van der Kooij 2002:70).

[130] Some scholars see the language as basically Aramaic, (Hoftijzer and Van der Kooij 1976:267, 300), others think it is basically Canaanite, and several scholars hold this language to be neither Aramaic nor Canaanite and characterize it as 'Proto Aramaic', an intermediate stage in the evolution of Aramaic. For a survey see Moore 1990, 7, note 27; Lipiński 1994:105-159, Levine 2003:140-145; Puech 2008:25-48.

Other inscriptions on stone and pottery found in phase IX
Two artefacts mention the name *Shera*. The first is a round limestone stone inscribed with the text: *Eben (stone of) Shera,* found in room 205; the other one is a jug from room 418 with the name *Shera* scratched onto the shoulder after firing (Van der Kooij and Ibrahim 1989:94, no. 32,101: no. 97; Franken 1991:15, plate 16). From the same phase, an inscribed rim fragment of a pottery bowl has been found. The first six letters of the alphabet were written into the wet clay of the rim before firing. In the sequence the two letters *he* and *waw* were left out. Probably the whole alphabet was originally written on the bowl (Van der Kooij and Ibrahim 1989:97, no.63 fig. 63).

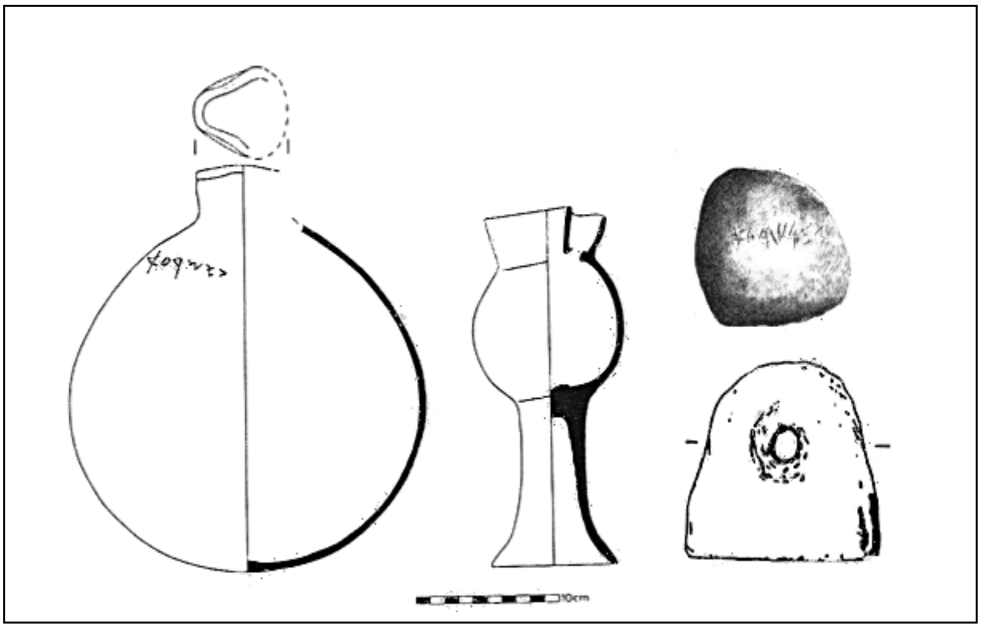

Fig. 12.7. From L to R: Jar with inscription 'Shera'; libation goblet on a tall foot, (the object is 24 cm high, max. width is 10 cm); stone with the text 'Stone of Shera', measuring 14 cm in diameter; 'outsize loom weight' (not available for study) measuring ± 12.5 cm in height and ± 15 cm in width at the base, with a perforation of ± 2.5 cm, weight unknown. (After Franken 199: fig. a; 2008:45, figs. 3 and 4.

Exotic or luxury objects found in phase IX
Among the finds were two libation goblets on a tall foot, one from room 205, the other from room 418 (Franken 1991:15; 2008:44-45, fig. 3), and an unknown number of human figurines, some of the heads were made in moulds, the bodies are flat, not pillar-shaped. Most of the figurines were naked males only wearing a belt, and naked females wearing necklaces and bracelets, some of them holding an object (fig. 12.9); Franken 1960: pls. 14 and 15; 2008:46-48 figs. 5; Van der Kooij and Ibrahim 1989:104-105 nos. 124, 125, 127 (heads) 126 and 129, 128 (female figurines). No. 129 is a fragment of the body of a figurine showing painted stripes indicating her clothing, she holds an unidentified object; the head (126) was made in a mould and could be attached to the body (129) by a peg (Van der Kooij and Ibrahim 1989:104-105, nos. 126 and 129); One of the females (128) (fig. 12.4 right) shows incised lines indicating her dress (or perhaps her trinkets); she holds a tambourine. This figurine is similar in style to the figurine published by Franken (2008:46 fig. 5) characterized as a vestal virgin (fig. 12.9 left). The headless naked female holds a round object in her hands, the body shows incised ornaments: a necklace, a belt and trinkets (resembling the ornamentation on figurine 128). Franken interpreted this figurine as a fetish instrumental in magical acts, because of red stains found in the obviously shaped public area. Some other finds from this period include a figurine of a monkey with a baby monkey on her lap (Franken 2008:47, fig. 6); a carefully carved and polished serpentine spoon (Van der Kooij and Ibrahim1989:101, no.8); two miniature bowls made of pottery (Van der Kooij and Ibrahim 1989:94, nos. 29-30); several fragments of bone inlays and a decorated bone pendant (Van der Kooij and Ibrahim 1989: 99-100, nos. 86-88); an 'outsize loom weight' (fig. 12.7), interpreted by

the excavator as one of the cultic objects found in room 205, belonging to the complex of four rooms (303, 418, 205 and 308) situated to the north of the room with the Balaam inscription (fig. 12.6). Franken interpreted room 308 as a weaving room (Franken 1991:15, plate 16; 2008:44-45, fig. 3).

Textiles
Several fragments of textile were found. Most were carbonized threads retrieved from the perforation holes of loom weights. A small fragment of fabric, measuring 52x32 mm, was lying in situ between 38 loom weights. The fabric turned out to be a very fine hempen cloth, a textile rarely encountered in the Ancient Near East. Deir Alla is the only place in the Levant from which hempen cloth has been recorded. The use of hemp as a textile fibre was thought to be limited to the regions of the Black and Caspian Sea in the Iron Ages (Chapter 6). Cloth made of hemp as produced in Deir Alla was exceptional. A unique kind of textile suggests that it might have been produced and used in special circumstances. The room in which the hempen cloth was found together with the loom weights of the loom on which it was woven was situated next to the benched room with the Balaam inscription. As already suggested by Franken (2008:25-52), an association between these finds has to be considered.

The function of Deir Alla
Deir Alla phase IX thus provides us with information about its inhabitants through artefacts and structures that were left in the sealed destruction layers. A surprising number of artefacts are related to food production and the textile industry (Van der Kooij and Ibrahim 1989; Vogelsang-Eastwood 1989; Vilders 1992; Van der Kooij 1993; 2002; Petit 1999; Boertien 2004). The numbers of loom weights suggest production of textiles for exchange (see Chapter 6). The complex of rooms, however, does not show a regular pattern of houses or dwellings, as one would expect in an ordinary village, and the presence of the benched room with a large inscription needs explanation.

Several interpretations have been proposed.[131] The excavator of the benched room with the Balaam inscription suggested that a sanctuary was located in the Iron Age village (Franken 1976: 4, 8 and 13; 1975: 322; 1999; 2008:40-48). “The combination of the artificial hill (tell) with the building on top, the Balaam text and a number of associated objects justify the present attempt to interpret the ruins as the remains of a Baal height.” (1999:193). He suggested that the three rooms (the benched room EE335 and the two rooms to the south of it (figs. 12.6 and 12.8) formed a small rectangular complex without doorways, representing a cave. “The room with two adjacent rooms on the south is an integrated part of one large complex (….). It was the place of revelation where the seer “saw” the meeting of the gods. (…). The seer gave oracles, had dreams, interpreted dreams and was a healer.” (Franken 1999:195). Franken sees the function of Deir Alla as a sanctuary built as a maze, where legends of ancient local heroes and demigods – Balaam the seer and Jacob the Lame – were told (Franken 1999:200). He concluded that the rooms reserved for weaving, resembling those described for Jerusalem (2 Kgs. 23:7), in combination with some remarkable finds such as a libation vessel, a stone with the name ‘Shera’, a ‘symbolic loom weight’ and a fetish of a ‘vestal virgin’, suggest that Deir Alla was an architecturally developed version of a *bama* or ‘Baal’s height’ (1999:200, 2008:40, 43-46). Vilders (1992:192) concludes that the Iron Age complex of Deir Alla had a practical as well as a religious function. She draws attention to a comparable complex at Beth Shean upper level V: storerooms and workshops belonging to a central administration building or a sanctuary. Wenning and Zenger conclude that no continuity exists between the Late Bronze Age temple and the benched room, because these buildings were not located on the same spot on the tell, and because there was a time gap of at least 200 years between the destruction of the Late Bronze Age temple and the building of the Iron Age village. This causes them to reject the idea that the room was a sanctuary. They came up with an alternative interpretation for the benched room: a meeting-room for local prophets

[131] For a survey of the discussion see Wenning and Zenger 1991: 189, note 110.

(1991:172, 181, 193). Zevit, on the other hand, states that the Balaam inscription defines the room as a shrine, despite a lack of supporting artefactual evidence (2001:250, note 201). He considered it to be ‘a place of theophany and blessing, a propitious place of sacred power.’ (2001:378). Van der Kooij assisted in the publication of the Balaam inscription (Hoftijzer and Van der Kooij 1976) and acted as co-director of the excavations at Tell Deir Alla from 1979 on, and rejects altogether the interpretation of the complex of phase IX as a religious centre. He suggests that the benched room was a classroom (for the teaching of writing) within an agricultural village, where weaving and the exchange of raw materials and products played an important role (Van der Kooij and Ibrahim 1989:87; Van der Kooij 1993:341). He writes: “Historically, texts of this kind may have a religious use, but also had a use in a teaching context (‘classroom’).” (2002:69).

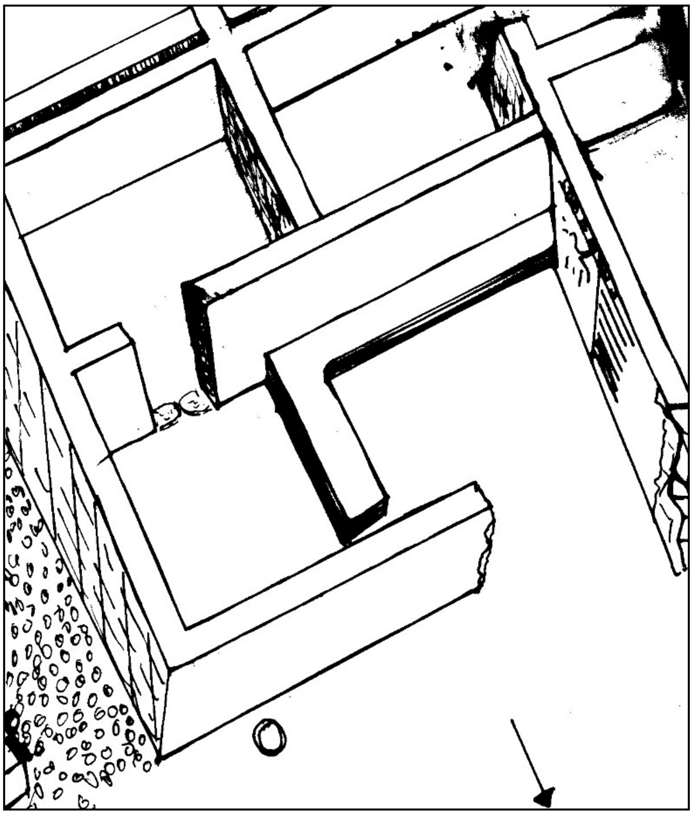

Fig. 12.8. Reconstruction of the room with the plaster text.

A cultic site?

These analyses show that there is no consensus on the interpretation of the function of the settlement of Deir Alla phase IX, or on whether the complex was a Baal’s height, a school, a meeting place for prophets or an ordinary village. However, the site can be determined as cultic by applying the criteria of Renfrew and Bahn, and Coogan, and the terminology of Zevit (see above).
When applying the criteria of ritual designed by Renfrew and Bahn to Deir Alla phase IX, the following criteria are relevant. Focusing of attention (aspects 2 and 3). The benched room with the text on the plastered wall differs from the other rooms in the cluster. The room can be regarded as a special building/place, set apart for sacred functions. In the room are special features, the benches, on which movable equipment could be placed such as lamps, censers, and altars. Architecturally the benched room is a common form of sanctuary in the Iron Age.
Boundary zone between this world and the next (aspect 1). Both forms of ritual are possible in the case of Deir Alla; the text was either on conspicuous public display, or it was an exclusive mysterious text on the wall of a hidden room. Presence of the deity (aspects 1 and 2). In Deir Alla association with the deity or deities is represented by the story of Balaam, and by the sphinxlike figure drawn on the plaster above the text. The text on the wall mentions the myth and the names of the deities. Participation and offering (aspects 5 and 7). The benches in these rooms are

generally interpreted as places for votive offerings. Some of the human figurines found at the site may have functioned as votive offerings or as fetishes as suggested by Franken (2008:46). The writing of the text and its illustrations can be seen as a great investment of wealth as a professional writer applied the text. Based on these criteria from Renfrew and Bahn, the benched room EE335 with the Balaam inscription on the wall may be considered cultic.

When applying Coogan's criteria to room EE335, the following can be said:
Isolation*:* this aspect is not directly applicable, because the benched room EE335 was situated within the village. From the plan it seems that the room was part of the habitation structure, although according to Franken the three rooms formed an isolated part of the building, without entrances from outside. However, whether the cluster of rooms really had no entrances is uncertain as the northern wall was damaged over more than half of its length. Exotic materials were found: the plaster text was found in the benched room, and in the buildings related to this room a special kind of textile (hemp) was produced, while exotic materials such as figurines, a libation goblet, an inscribed stone reading *ewen Shera* and an inscribed jar reading *Shera* were found in combination with domestic items. Continuity is not directly applicable because the Iron Age benched room was not situated directly above the Late Bronze Age temple,[132] but continuity cannot completely be ruled out because the Iron Age cultic structure was situated on the same site (Franken 2008:40). Parallels: in Levantine archaeology it is generally accepted that benched rooms can define a structure as cultic. Dever stated that the benched temple is the predominant local Palestinian type, with a history that stretches back as far as the Chalcolithic period (1987:223). Gilmour classifies the bench in the cultic structure at Ai as a Canaanite feature (1987:25), and Nakhai uses the term 'Canaanite benched temple' when she compares cult room 49 at Lachish Stratum V to the temple of Tel Mevorakh Stratum XI (2001:179).[133] Because plastered or other benched structures are never found in domestic rooms, but only in rooms within domestic buildings that can be identified as cultic on other grounds, burial caves, gates and in structures identified as cultic on other grounds, it may be assumed that rooms with benches running alongside some or all of the walls can be characterized as a sanctuary or a temple. Thus, according to the criteria of Coogan too, it is again probable that room EE335 had a cultic function within the settlement.

Using the terms designed by Zevit Deir Alla phase IX can be defined as a *'*cult site' – a general designation for a place where cultic acts took place ('cult place'), with at least a room designed for cultic purposes in a domestic or a public building, or attached to such a building ('cult room').

[132] During the Late Bronze Age a sanctuary existed at Tell Deir Alla, surrounded by 'treasuries' containing the pottery and other items used in the sanctuary, and gifts offered to the sanctuary, and by service rooms (Franken 1992:163). The first sanctuary was built on an artificial hill constructed over the Middle Bronze Age occupation (Franken 1992:11-12). Earthquakes and conflagrations have destroyed this sanctuary several times. The final end of this sanctuary is dated to somewhere after 1180 BC. The next building phase has been found east and west of the temple, and there are no indications that these structures had a religious function or were connected with a sanctuary (Van der Steen 2002:132-133). The loom weights from the Late Bronze Age have not been studied.

[133] Late Bronze Age structures with benches lining the walls, interpreted as cultic, have been found at several places, including Hazor Lower city LB IIA and Hazor LB IIB (Yadin, Aharoni, Amiran 1989:40,fig. 6). Megiddo VII A temple 2048 (Loud 1948:fig. 247; Kempinski 1989:183; Mazar 1992:172).
Iron Age benched cultic rooms are found at Ai room 65 (Marquet-Krause 1949:23, Nakhai 2001:173); Arad northwestern corner of the Ion II royal fortress, (Aharoni 1968:19-20; Herzog, Aharoni and Rainy 1987:28-29); Hazor stratum XI room 3283 (Yadin 1972:132-134); Horvat Qitmit (Beith Arieh 1991:96; Zevit 2001:143, fig. 3.10); Tel Miqne-Ekron strata V and IV, temple 300 and 350 (Dothan 1998:156; Gitin, Dotan and Naveh 1997:8-9); Tel Qasile stratum XII temple 319, stratum XI temples 200 and 300, stratum X temple 131 (Mazar 1980:17-28, 33-41); Tel Qiri stratum VIII area D (Ben Tor and Portugali 1987:82-89).

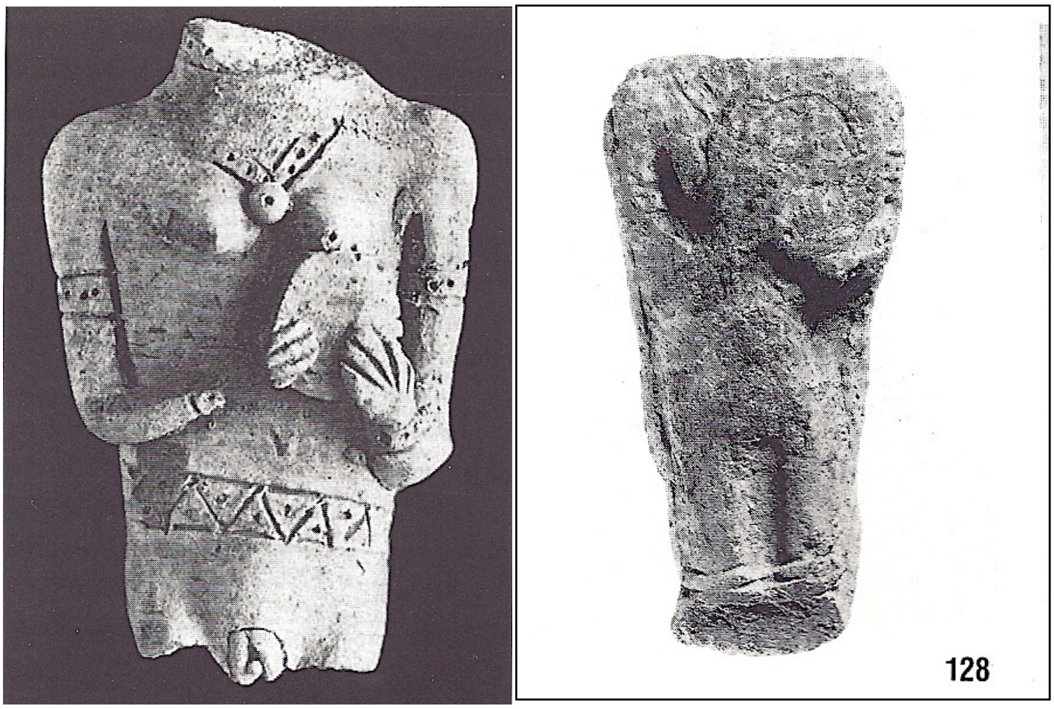

Fig. 12.9. Female figurines from Deir Alla (left Franken 2008:46; right Van der Kooij and Ibrahim 1989:105).

Conclusions

The discovery of several fragments of hemp cloth in phase IX is very unusual, as hemp cloth has never before been reported from Iron Age levels in the Levant. Linen is the most commonly used plant fibre. The presence of this special type of cloth in the same complex in which a cult room with a religious inscription is found raises the question of whether this special kind of cloth could have had a cultic use. The huge number of 600 loom weights recovered from phase IX suggests that the inhabitants wove textiles not only for their own use, but also for exchange and/or to be used at the site in a cultic context. This supports Franken's (1976:13) proposal of a relationship between the textile production at the site and its religious function. But Franken's later interpretation (ref) of the complex as a Baal's height with rooms for weaving related to a temple seems rather far-fetched in premise and interpretation. Interpretations as classroom or prophet's meeting place are not supported by the excavated remains or by any methodological considerations.

12.6 Kuntillet Ajrud (Horvat Teman)

Kuntillet Ajrud is located in the eastern Sinai desert some 50 km south of Kadesh Barnea (Old Israel grid 09489554, UTM 63773404). It is built on top of a steep hill, along a road leading into the Sinai desert, and close to water wells. Z. Meshel excavated the site in three seasons from 1975-1976, published by him in 1978 and 1992, followed by the final publication in 2012 (Meshel 2012). Many fragmentary Hebrew inscriptions were found and translated by Zevit (2001:372-404) and Ahituv, Eshel and Meshel published new translations and interpretations in the final publication (2012:73-142). The structure was dated to c. 800 BC by the excavator (Meshel 1978; Meshel 2012) (fig. 12.10). The main western building is rectangular in shape (15x25 m) and consists of a large central courtyard, surrounded by long casemate-like storerooms with projecting corner towers on three sides. The entrance was on the east side. The complex was accessed through a gate chamber, creating a bent axis approach into a broad room. This room was narrow, with benches along the walls. Staircases in several parts of the building gave access to a second story.

The second building, on the east side of the mound, is poorly preserved. The entrance to this complex was on the west side, and its walls were plastered with white lime both inside and out, and decorated with geometrical and floral designs in red and black paint. It may have been a *propilaeum* to the main building, or the eastern wing of a front courtyard, but it is also possible that the two structures did not coexist and that the eastern building was in use earlier than the main building. The bent axis entrance room of the main building was similarly decorated with floral motifs. It had benches along its eastern and northern walls and, surprisingly, in the open, southern part of the 'bend' a bench was constructed running east-west into the plaza. The *broadroom,* which was entered through this entrance room, had plastered walls and benches along its walls as well. Its entrance divided the room into two wings. The plastered stone benches along the walls of each wing occupied most of the area, with only a narrow passageway in between. This construction gave the room its name, 'bench room'. The benches appear to have been the most important element in this room. The way the room was connected to the adjacent tower rooms may attest to its use: these rooms communicate with the benched room through raised, window-like openings that have the side benches as their sill. According to the excavator "most of the vessels were found in these corner rooms, perhaps used as favissae" (Meshel1993:1459; Meshel and Goren 2012:11-59).

Kuntillet Ajrud has been interpreted in different ways: Meshel interpreted the site as a fortress, although the main building was architecturally different from the Negev fortresses because it lacked casemates and gates. The entrance was a gate sanctuary and, according to Meshel (1978) the site lacked designated living areas. Meshel regarded the site as a desert fortification with a sanctuary devoted to YHWH and His Asherah (Meshel 1979:28). According to Meshel, Kuntillet Ajrud had a religious character (Meshel 2012:65-69). Sheffer and Tidhar (1991:1; 2012:289) interpreted the site as a desert precinct with a cultic function, and Dever (2005:160) interpreted it as "…a fort; but it also serves quite sensibly as a sort of 'inn'; and it has, as other sites do [..] an indisputable 'gate shrine'." He also agrees with Meshel that there is a favissa. Most authors agree that Kuntillet Ajrud was a fortress with a cultic function. Whether a cultic function can be attested from the finds will be discussed in the following sections.

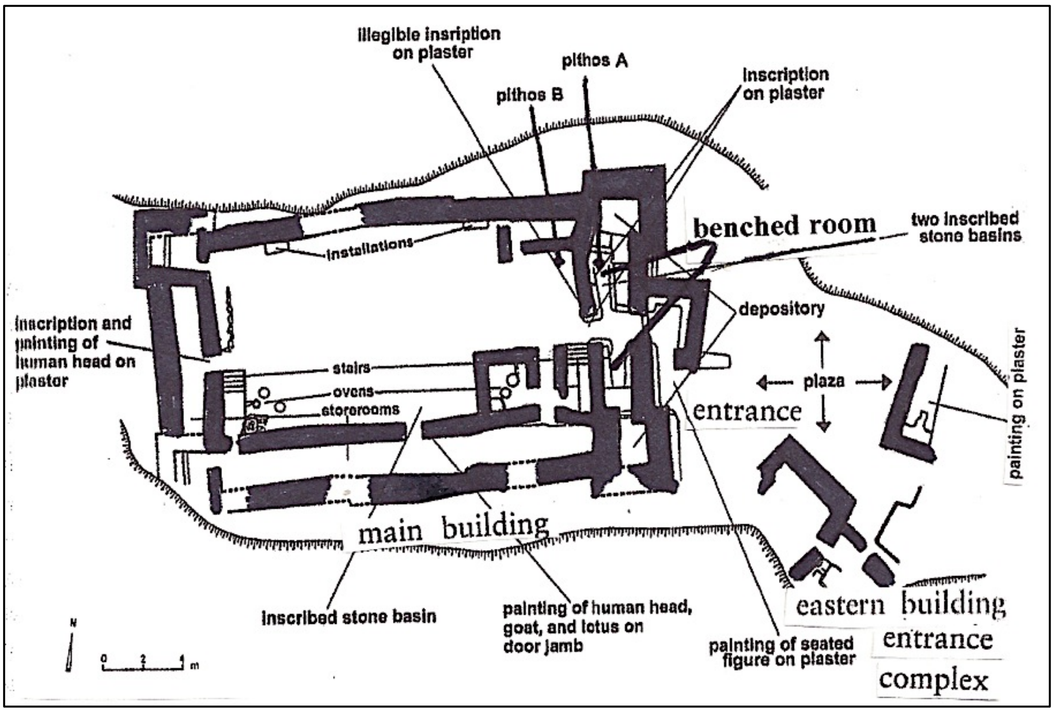

Fig. 12.10. Plan of Kuntillet Ajrud (after Zevit 2001:371).

Textiles found at Kuntillet Ajrud
In Kuntillet Ajrud, some hundred textile fragments have been found, as well as a bundle of flax fibres, yarn for weaving and twisted thread for sewing. The textile fragments are small; most are less than 5 cm in length, a few are about 20 cm and only two are about 50 cm in length. No item was complete enough to be identified as part of a particular garment or textile object, but all consisted of high quality textiles reflecting skilled craftsmanship (Sheffer and Tidhar 1991:14). Piles of thread and scraps of cloth were recovered from three locations: (1) in the southern storeroom, next to 16 loom weights; (2) near the staircase leading to the second floor of the same storeroom, while (3) outside the enclosure a blackened bundle of fabric and some scraps of textile were found together with remains of cords and a textile impression on a clay jar stopper (Sheffer and Tidhar 2012:313-315). The overall quality of the textiles is good, the weave generally even and tight, the sewing and repair work done with small dense stitches. Chemical analysis and microscopic examinations of the fibres showed that most items were woven from bast fibres, either flax or hemp. In order to distinguish between the two, Sheffer and Tidhar examined the spinning direction. All threads were found to be S-spun,[134] and so the fragments could be identified as flax/linen (Sheffer and Tidhar 1991:3). Six linen fragments had a blue line decoration in the weft (Sheffer and Tidhar 2012:301, fig. 9.16). Eleven items were made of wool. They were un-dyed and extremely worn. These were found in the northern part of the courtyard; while the linen items were found in the eastern and southern store rooms. The presence of loom weights and heaps of threads, woollen threads among them, suggests that both linen and woollen fabrics were produced at Kuntillet Ajrud (Sheffer and Tidhar 1991:11; 2012:307). Three fragments were identified as *shaatnetz*, a mixture of linen and wool (see below). Two of these were un-dyed, both made with linen warp and wool weft. The third fragment combined red wool and blue linen ornamentation. Originally there may have been more coloured decorations but because of the extreme fading of the cloth this could not be determined. The blue threads were dyed with indigo (*Indigofera tinctoria*) and woad (*Isatis tinctoria*); the red woollen threads were dyed with *alizarin*, a red dye produced from the madder plant (Sheffer and Tidhar 1991:8; 2012:304).[135]

Two groups of loom weights were excavated: a group of ten weights was found in the entrance to the western storeroom, while another 16 loom weights came from the southern storeroom. It may be assumed that originally there were many more loom weights, but these may have disintegrated as they were made of unfired clay. Several wooden beams were excavated, which belonged to a loom (Sheffer and Tidhar 1991:11; Meshel 2012:42, fig. 2.57; Sitry 2012:317). Evidence that weaving was carried out at Ajrud is provided by remnants of wool and threads and by the loom weights found at the site (Sheffer and Tidhar 2012:307).

Most of the textiles in Kuntillet Ajrud were made of linen and only a small percentage was made of wool. Locally available raw material for producing yarn was sheep's wool; flax fibre was not available in the environs.[136] It is likely that linen yarn (and not the raw fibre) was brought to the site to produce linen cloth, but it is also possible that the finished cloth or even linen garments were transported to the site. Linen garments were used both in domestic and cultic units[137] and thus the linen cloth fragments from the site do not necessarily support the idea that the textile production at Kuntillet Ajrud was cultic.
At Kuntillet Ajrud, three different cloth fragments have been found that were made of a combination of wool and linen. The significance of the textiles for interpreting the site lies in the

[134] See above, note 4.
[135] See Chapter 2 for a description of these dyes.
[136] The Jordan Valley was famous for growing flax and the production of linen (Chapters 6, 7 and 10).
[137] Linen garments had a special cultic significance in Egypt and Mesopotamia and in ancient Israel. In Mesopotamia linen garments characterized a person as a priest (Oppenheim1969, cited by Sheffer and Tidhar 1991:23). According to the Hebrew Bible priests had to wear linen garments in the cult (Ex. 28:42-43). In Ezekiel 44:17-18 wool is specially mentioned as forbidden for priests within the gates of the inner court of the temple. At the same time, linen was the clothing of the Israelite male (Isa. 5:27, Jer. 13:1). This twofold use of linen, cultic versus domestic, is also mentioned in neo-Babylonian documents (Oppenheim 1949:178).

presence of this type of cloth. The largest piece is cloth item 102 with its combined decoration of red wool and blue linen. Some additional scraps of un-dyed linen /wool cloth were also found, made with linen warp and wool weft. The word *shaatnetz* is mentioned in the Hebrew Bible; it is used for textiles made of a mixture of linen and wool. Wearing garments made of s*haatnetz* is prohibited for common use according to Lev. 19:19. However, the sacred clothes for the High Priest were made of a mixture of wool and linen as ordained in Ex. 28:4-8. Textiles made of a combination of linen and wool s*haatnetz* have hardly ever been found (world wide), which might be due to the fact that the mixture causes problems when washing the fabric. Wool and linen need different treatment and when combined in one cloth can cause uneven shrinkage, disordering the structure of the cloth. Only very careful handling can avoid this problem. Dyed wool gives brighter colours and is easier to produce than dyed linen threads. This could have been the reason for combining the two materials.[138] *Shaatnetz* appears to be a very impractical kind of material that cannot be used in daily life. But such an impractical cloth made out of coloured wool, combined with blue and white linen could be an indication for its cultic use in Kuntillet Ajrud.

Inscriptions found at Kuntillet Ajrud
The complex yielded many inscriptions written on wall plaster, pithoi and stone vessels. The language has been identified as Old Hebrew, the script being 'Phoenician' (Meshel 1993:1461; Ahituv, Eshel and Meshel 2012:73-142).

Finds in the benched room
On the wall plaster of the benched room, fragments of three inscriptions were found (Meshel 1993:1461; 2012). On the doorjamb of the entrance leading from the benched room into the courtyard was the only wall inscription that was discovered *in situ*. It was extremely fragmentary and faded. Only very small parts could be preserved, and the inscription as a whole was illegible (Meshel 1963:1462; Zevit 2001:372). The second inscription 4.2 (Meshel 2012:110-114, figs. 5.1, 5.53, 5.54, 5.55a, 5.55b) was found near the western entrance into the benched room, and was possibly part of the previous inscription.

The text is partially legible:

..] second time/years[..
in earthquake. And when God shines forth in the [heights. Y]HW[H
R The mountains will melt, the hills will crush [...
earth. The holy one over the gods[...
prepare (yourself) to bless Baal on a day of war
to the name of El on a day of wa[r...

Translation Zevit (2001:372-373).

And in the shining forth of El at the he[ad
of the mountains
And the mountains will melt [like wax
beneath him
And the knolls will be crushed [in Mount
Bashan
And six on]
to bless Baal on the day of w[ar
to the name of El on the day of [war

The third inscription was reconstructed from more than 20 plaster fragments found in situ (Meshel 2012:105) near the west wall of the benched room.

[138] The only colour observed on both early and late linens in general is blue (Sheffer and Tidhar 1991, 6 and note 14).

Inscription 4.1 (Ahituv, Eshel and Meshel 2012:105-107, figs. 5.49, 5.50a, 5.50b).

...may he lengthen their days and may they be sated...recount to [Y]HWH of Teman and his Asherah...
...because (?) YHWH of the Te[man] has shown [them(?)] favour, has bettered their da[ys...

Translation Zevit (2001:373).

l]engthen their days and they will be
filled, [and they] will give to
[Y]HWH Teiman and to Asherat[
]do good, YHWH (of) the Tei[man]

In the benched room the drawings on the wall plaster, several of which are in black, red and yellow, differ in subject matter from the depictions on the pithoi and are more decorative. On the wall plaster in the entrance to the benched room, a figure was depicted seated on a throne, holding and smelling a lotus flower (Meshel 1993:1463; Beck 2012:184-197, figs. 6.40-6.41).

Several inscribed votive offerings were found, among which were two inscribed stone basins.
Inscription 1.1 (Ahituv, Eshel and Meshel 2012:75) reading Smayaw son of Azzur (according to Zevit (2001:381) *Shemayo son of Ezer*). And inscription 1.3 (Ahituv, Eshel and Meshel 2012:77) *Sibbol son of Halyaw*. (Here Zevit (2010:381) only reads reads *hlyw*).
Among the inscriptions were four repetitions of the alphabet, with the letter *p* preceding *ain* (Meshel 1993:1462; Meshel 2012:75-78, figs. 2.75, 2.76, 5.6); Abecedaries inscriptions 3.11-3.15 (Ahituv, Eshel and Meshel 2012:102-103 figs. 5.30, 5.40, 5.45-5.46).

The sherds of a large pithos A (Meshel 2012:165-173, figs. 6.20-6.23) found here bore an inscription and drawings in red ink. It also bore the incised letter combination *quf resh* on the shoulder.
The drawings on pithos A consisted of well-known scenes:
Scene 1: Two figures resembling the Egyptian god Bes with a female lyre player nearby; a cow licking the tail of her nursing calf (Meshel 2012;152-156, figs. 6.10-6.12). The scene is overwritten by a two-line inscription, reading:

Inscription 3.1 (Meshel 2012:87, figs. 5.26-5.29).

Message of '[..] M.-K: Speak to Yaheli and to Yoasa and to ....I have [b]lessed you to YHWH of Shomron (Samaria) and to his Asherah

Translation by Zevit (2001:390).

Said E[ ] the.. ?:'Say to Yehal['el] and
to Yoasah and to ..[PN: (23 slots) *I*
b]lessed you
to YHWH of Shomron and to
Asherathah.' [139]

Scene 2. Two ibexes flanking a tree, a lion and a row of four nondescript animals (Meshel 2012:152-156, fig. 6.10-6.11). No inscription.

Finds outside the benched room
Fragments of wall inscriptions were found in the debris of the entrance to the western storeroom (Meshel 1993:1461; Meshel 2012:120-122). On the plaster fragments, two illegible letters and the drawing of a head in profile could be discerned. Drawings found in the debris of the eastern building were made in red, black and yellow and showed a running panther, two rows of lotus flowers, two lines of guilloche and a checkerboard pattern with red and yellow squares, and

[139] See the discussion on Asherathah in Zevit 2001: 400-405.

human figures at the top of a wall with crenellated towers (Meshel 1993:1463; Beck 2012:184-197).

The sherds of *large pithos B* were found in the northeastern part of the courtyard. The pithos bore an incised letter *ain* on the shoulder. There is only one scene on the pithos. The drawing (fig. 12.11) is made in red ink and shows five figures in procession raising their hands (Meshel 2012:173-177), an archer shooting a bow, two cows, an ibex, and some nondescript figures. There are several inscriptions on this pithos. One of them is written partially over the procession of worshippers.

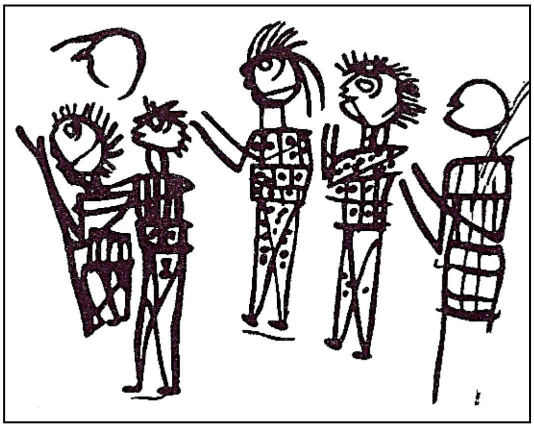

Fig. 12.11. Group of people in procession. Pithos B Kuntillet Ajrud (after Beck 1982:10 fig. 6).

Inscription 3.6 (Meshel 2012:92-98;figs. 5.1, 5.35, 5.36, 6.2).

Message of Amaryaw
Say to my lord, are you well I have blessed you by YHWH of Teman and his Asherah. May he bless you and may he keep you and may he be with you my lord [forever (?)]

Two additional inscriptions were painted on the pithos, the words *peace* and *Samaria* are only partly visible. Below these letters is another inscription.

Inscription 3.9 (Meshel 2012:98,figs. 5.14, 5.42a, 5.42b, 5.35).

To YHWH of the Teman and his Asherah
whatever he asks from a man, that man will give him generously.
And if he would give -YHWH will give him
according to his wishes

Translation by Zevit (2001:398).

]for/to YHWH (of) the
Teiman and to Asheratah
all that he asks from a man who acts
compassionately he [?], and YHWH will
give him according to his heart.

The inscriptions were partly covered by three incised abecedaries each forming a horizontal band of letters around part of the pithos.

Four inscriptions were found incised on the rims of stone bowls. The most complete inscription was inscribed on a large stone basin weighing about 200 kg that was found near the entrance to the southern storeroom.

Inscription 1.2 (Ahituv, Eshel and Meshel 2012:76, figs. 2.75, 2.76 and 5.3, 5.6).

To/of Obadyaw son of
Adna, blessed be he to YHWH

Translation by Zevit (2010:380).

(Belonging) to Obadyo son of Adnah. His is blessed to YHW[H]

The pithoi and storage jars are not locally made. Based on Neutron Activation Analysis of the sherds, Gunneweg (Gunneweg at al.1985) concluded that the pithoi were made in the environment of Jerusalem, and that the storage jars were produced somewhere in the southern coastal plain, while the Samaria ware pitchers were probably from northern Israel (Gunneweg at al.1985:272-283). It is thought that the pithoi were sent from Jerusalem to Ajrud (and to Beer Sheba and Arad, where similar pithoi were excavated) containing a liquid not locally available in the arid region (Zevit 2010:379).

A cultic site?

Kuntillet Ajrud has been interpreted as a fortress, although the main building differs architecturally from the other Negev fortresses. Meshel has suggested that the site served as a religious centre on the road to the Red Sea serving Israelite trade activity (1978). Other suggestions include a scribal school, a caravanserai or a fortress with a small sanctuary (Dever 1990:140). According to Dever, "(T)he site is a typical Middle Eastern caravanserai or stopover station on one of the desert routes crossing the eastern Sinai, […], it is a fort; but it also serves, quite sensibly, as a sort or 'inn'; and it has, as other sites do, (…) an indisputable gate shrine." Dever identifies the back part of the bench rooms as a *favissa* (2005:160). Zevit classifies the whole structure at Kuntillet Ajrud as a sacred structure, "planned in advance for a certain purpose, and that its *raison d'être* was cultic*."* (2001:374). Significant finds at Kuntillet Ajrud are the textiles, the inscriptions and the drawings. Meshel has interpreted the stone bowls with the inscriptions as offerings by donors seeking a blessing (1993:1461; 2012:65-69).

Although most authors agree that Kuntillet Ajrud was cultic in some way, the criteria of Renfrew and Bahn, Coogan and the terminology of Zevit will be applied here to clarify the arguments and to enable comparison with Tell Deir Alla. The following criteria of ritual designed by Renfrew and Bahn to Kuntillet Ajrud are relevant:
Focusing of attention (aspects 3 and 4*).* Architectural characteristics. A benched room is a common form of sanctuary in the Iron Age (see 12.3); plastered benches, texts and illustrations on the plastered walls; movable equipment: decorated pithoi, special textile (*shaatnetz*) The sacred area is rich in repeated symbol 'redundancy'. Artistic motifs such as a lotus flower and horned animals were found on walls and doorjambs of the entrance to the long chamber at the west end of the courtyard. Boundary zone between this world and the next (aspect 1*).* In the case of Kuntillet Ajrud the texts were on conspicuous public display and visible to those inside the fortified building (window-like openings in the bench room). Presence of the deity (aspects 1 and 2) may be reflected in the usage of a cult image, or a representation of the deity in abstract form. Animal symbolism (of real or mythical animals) may be used, with particular animals relating to specific deities or powers. In Kuntillet Ajrud the association of the deity or deities is represented by the drawings and texts on plaster showing both literary and artistic motifs that were well known. The texts on the walls and on the pithoi depict and also mention the names of the deities. Several ritualistic symbols and motifs are used on the pithoi, iconographically related to the deities' worship and to their associated myths, such as suckling calves, ibexes and ibexes flanking a tree and nibbling the branches. Participation and offering (aspects 1, 2, 5 and 7). Worship will involve prayer and special movements – gestures of adoration – and these may be reflected on Pithos B showing a group of people in procession, all of them with their arms in the same position (fig. 12.5) (Meshel 2012:145, 148-152, 173-177, figs. 6.2, 6.6, 6.26, 6.27a; discussion in Zevit 2001:392-394). The ritual may employ various devices for inducing religious experience (such as dance, music). Pithos A shows a seated lyre player and two Bes figures, the position of their legs suggesting dancing. All kinds of material objects may be brought and offered (votives). The

benches in these rooms are generally interpreted as places for votive offerings, including inscribed ones. Letters inscribed on pottery vessels before firing may indicate offerings and tithes. It has been suggested that the letters *qof* and *resh* stand for *qorban* (sacrifice), while *yod* indicates tithes, paying one tenth of the first or best harvest of the season (Zevit 2001:379). The rooms provided a physically aesthetic setting, within which certain activities could take place. The writing of the text and its illustrations can be seen as an investment of wealth and resources, as do the drawings on the pithoi and the effort of bringing the pithoi from Jerusalem to Kuntillet Ajrud. The (gate) sanctuary was a dedicated structure and it was planned in advance.Thus the criteria of Renfrew and Bahn (1991:358-363) lead to the conclusion that the site can be regarded as cultic.

Three of Coogan's criteria can be applied to Kuntillet Ajrud. Isolation is applicable to Kuntillet Ajrud, if the site (or part of the site) was indeed planned in advance as a remote sacred structure. If the site functioned as a fort and a stopover station on a crossroads in the desert, then the place is remote but it is not isolated. Part of the structure had a sacred function. Exotic materials are found. Texts and figures painted on plastered walls, the benched room, the special kind of textile that was made in the buildings related to this room and the painted pithoi and the inscribed stone basins can be regarded as exotic. Continuity is not applicable because the site seems to be a one-period site. Thus, according to the criteria of Coogan, it is probable that Kuntillet Ajrud was a cultic site. Using the terms designed by Zevit (2001:123-124), Kuntillet Ajrud can be defined as a cult site, with at least a room designed for cultic purposes in a public building, or attached to such a building (cult room).

Parallels

The architecture: In Levantine archaeology it is generally accepted that benched rooms can be defined as cultic structures; the site is entered from a gate shrine with two benched rooms (Dever 2005:160). Motifs and structures in textsinclude the names of gods and people (see below), literary constructions showing parallels with aspects of the Hebrew Bible (Zevit 2001:372-374, 390-392, 395-405; Dever 2005:128, 162-165). Well-known ritualistic motifs are used in artistic scenes, such as the lotus chain and guilloche border design, volutes, palmetto trees, grazing bulls or cows, a figure wearing an Egyptian collar holding a lotus, horned animals (probably ibexes: Beck 1982:48-59), the figure seated on a lion throne (Dever 2005:165-167).

For whom was the sanctuary at Kuntillet Ajrud?

Mazar attributes the religious activity at the site to an Israelite group, such as the Rechabites (1990: 449). The paleography and the reading of the motifs has led Zevit to conclude that the site represents a mixture of both southern and northern Judahite and Israelite religious practices (Zevit 2001:376, contra Meshel 1992:108-109; 1993:1464), while Dever characterizes it as a syncretism of Israelite, Canaanite, Phoenician and Egyptian worship (1990:140-148). In the final publication, Meshel (2012:68) describes the inhabitants as a group of Priests and Levites who were supplied by the provision of offerings and the tithes that were sent to them from Jerusalem. They practised a collective way of life to a certain extent. The priests offered religious services and blessings to desert travellers, caravan drivers and pilgrims to Sinai and Mount Horeb. One or several of them were well trained in writing. They taught the young apprentices who accompanied them. Meshel concludes from the inscriptions that there was some degree of hierarchy among them because of the inscription reading 'to the governor of the place'.

12.7 Comparison of both sites

The similarities between Kuntillet Ajrud and Tell Deir Alla are striking. Both sites are on a junction of trading routes and there are cultic elements in the material culture at both sites. One group of cultic phenomena is the mysterious abecedaries. In Deir Alla an alphabet was inscribed on the rim of a bowl (Van der Kooij and Ibrahim 1989:70). In Kuntillet Ajrud, four abecedaries were found, published by Meshel in his description of the ink inscriptions and drawings on pottery vessels. "Noteworthy among the inscriptions are four repetitions of the alphabet, with the letter *pe* preceding *ain.*" (Meshel 1993:1462; Ahituv, Eshel and Meshel 2012:102-103, Inscriptions nos.3.11-3.15). The function of these alphabets is not clear. The scripts used show an experienced writing hand, and therefore cannot be explained as a writing exercise. In the Graeco–Roman world, magical significance was attributed to the letters of the alphabet, either to the whole set or to parts of it. Letters were regarded as the manifestation of a mysterious power, and only those who possessed the knowledge were capable of knowing its secret (Haran 1986:93). Haran stresses the point that such an interpretation of Iron Age abecedaries is a retrojection, but I agree with Van der Kooij and Ibrahim (1989:70) that a magical/ religious explanation should be considered.

At both sites special textiles of high quality were produced, and the weaving activities were concentrated around a benched room that had religious texts and motifs painted on its plastered walls. Kuntillet Ajrud has been interpreted as a caravanserai with a shrine, where textiles were produced, at least partly for religious purposes. Likewise, the compound of Tell Deir Alla Phase IX can be regarded as the place of residence of a small group of people, living and working near a shrine complex, producing textiles not only for their own use and for exchange, but probably also for religious purposes. The second task is to determine a relationship between the production of textiles and a goddess, possibly Asherah.

Names and deities

Asherah is mentioned in Kuntillet Ajrud, whilst Deir Alla writes about the goddess Shagar. Shagar is the most important goddess in the pantheon of Deir Alla and as such she probably had the same function as Asherah in Kuntillet Ajrud. The textual material provides information about the pantheon to which the female goddesses belonged and this could be a chance to come closer to the deity for whom the weaving was performed.

Kuntillet Ajrud	**Deir Alla**
	The group of gods The Shadday gods /goddesses
Male gods El YHWH YHWH... the Teman YHWH of Shomron Baal	*Male gods* El Ashtar Mot
Female gods Asherah the consort of YHWH Asherah the consort of YHWH Teman Asherah the consort of YHWH of Shomron	*Female gods* Shagar (Shagar-we-Ashtar)

Table 12.1. The pantheons of Deir Alla and Kuntillet Ajrud

It is not clear whether *Shadday*, the council of the gods, which Balaam saw in his vision, consists of gods or goddesses; Hoftijzer suggests a feminine plural of *Shadday* (Hoftijzer and Van der Kooij 1976: 179, 275; Van der Kooij and Ibrahim. 1989: 69), while Lutzky (1998) regards Shadday as a goddess epithet.

In the texts from Kuntillet Ajrud, Asherah is the consort of YHWH. The combination of the names of Asherah and YHWH as a couple is not unique for Kuntillet Ajrud, because both Ekron (Tel Miqne) [140] and the burial cave Khirbet El-Qom (Makkedah) [141] yielded textual finds that mention the combination. These inscriptions seem to point to a cult that combined YHWH and his consort Asherah (Liverani 2005:140; Zevit. 2001:359-370). In the Hebrew Bible, in Deut.33:2-3, Asherah is mentioned with her title *Qodesh* (Qudshu). In 2 King.23:7 the *qedeshim* are supposed to be *the blessed*, involved in the cult of Asherah (Dijkstra 1998:85). Both El and YHWH are mentioned in Kuntillet Ajrud. Both names are also visible in the personal names from Kuntillet Ajrud, in the theophoric element *el* and *yo*/*yaw* (Table 12.2). The god YHWH is not mentioned in the plaster text from Deir Alla. The reason for this omission could be that YHWH is of southern origin (Liverani 2005:140) whilst in Deir Alla influences from the north (or northeast) are found in the language of the Balaam inscription (see above), the loom weights (Boertien 2004:312) and the grinding stones (Petit 1999:157).

Baal was the traditional god, or better the god-type of the countryside, along with the goddesses Astarte and Asherah (Liverani 2005:119). In Canaanite mythology Astarte and Baal were a couple, and as such they are also mentioned in the Hebrew Bible (Jud.2:13;10:6; 1Sam.7:3;12:10).

Kuntillet Ajrud	**Deir Alla**
Amaryo/Amariaw Amos Eliaw *Misri* Obadyo son of Adnah Shemayo son of Azzur/ Ezer/ Sibbol son of Halyaw/ *hlyo* Skanyaw Smaryaw Uzziaw Yaheli/ Yehal(el) Yoasah	Balaam son of Beor Shera

Table 12.2. Other names mentioned in the texts from Kuntillet Ajrud and Deir Alla phase IX.

Originally Asherah, Anat and Astarte were distinct goddesses, although sharing many characteristics, but sometime in the Iron Ages they merged into a triad of the female deities Asherah - Anat - Astarte (Oden 1976:34; Korpel 1998:108; Hoffner 1990:69-70 cited by Korpel 1998:102; Nakhai 2001:146, discussion in Zevit 2001:137 note 25). The triad of major Canaanite goddesses, and their Egyptian hypostatization Qudshu, also shared characteristics. Even though each goddess had a distinct character, the three goddesses shared attributes, titles and husbands (Oden1976:34). In every period the three goddesses could be worshipped separately or together.

In the Deir Alla text the goddess' name is Shagar, and she is associated with animal fertility (Hoftijzer and Van der Kooij 1976: 273).[142] In the text, the goddess Shagar is the one who announces doom to Balaam. Shagar is also referred to as a double goddess *Shagar-we-Ashtar*.[143]

[140] Written as *`šrt Asherat* (Meshel 1978), the name is used in an altar inscription excavated in Ekron /Tel Miqne (Gitin 1993: 250; discussion in Zevit 2001:400-405).
[141] The name Shagar is also known from Punic and Ugaritic texts (Hoftijzer and Van der Kooij 1976:273).
[142] The name Shagar is also known from Punic and Ugaritic texts (Hoftijzer and Van der Kooij 1976:273).
[143] The composition of the name is comparable to the Canaanite double gods Shaḥar-we-Salem and Sedeq-we-Mesar, known from Ugarit as the consorts of the originally Egyptian sun god Amun-Re (Dijkstra 1998:75, 82).

In the Hebrew Bible (Deut. 7:13; 28:4,18 and 51) the word *shagar* is also mentioned; in *Shagar-alapikha* it is parallel with *Ashtarot tzonekha* that might be translated as "the Shagar of your cattle and the Ashtarot of your cattle " (Keel and Uehlinger 1998: 208; Smelik 2006:103). The male god Ashtar is also a fertility god; apparently the writer of the text uses the names of two gods in combination with the fertility of animals. Ashtar is also known from the texts on the stele of Mesha from the nearby kingdom of Moab, where he is identified with the national god Kemosh (Hoftijzer and Van der Kooij 1976: 273). It is unknown whether the goddess Astarte also belonged to the local pantheon in Deir Alla, but according to Hoftijzer it is possible that Shagar has taken her place (Hoftijzer and Van der Kooij 1976: 274).

The textiles

Very remarkable fabrics have been found at both sites. In Deir Alla, fine hempen cloth and hemp threads were found amidst the loom weights of the loom on which it was woven, and many loom weights have been recovered from all over the site suggesting extensive textile production. Deir Alla is the first and thus far the only site in the Levant from which hempen cloth has been recognized and recorded.

The many textile fragments found in Kuntillet Ajrud do not necessarily point to extensive production, unlike the numbers of loom weights at Deir Alla. The climatic conditions in the Sinai allow textiles to be conserved much better than in other, more humid circumstances, which may be the reason that Kuntillet Ajrud yielded so many textile fragments. Of more importance are the kinds of material used to make the textiles. At Kuntillet Ajrud, textiles made from linen were found; only a few pieces were made of wool, which is to be expected in the Iron Age. But the unique find of several pieces of cloth made of a combination of linen and wool is significant.

The combination of cult and textile trade is a well-known phenomenon in antiquity, and workshops and storehouses in temple compounds have been recorded from Mesopotamia and Egypt. The archives of the Third Dynasty of Ur indicate extensive trade in textiles in the temples and palaces (Jacobson 1970:216, Waetzoldt 2010). These trading activities continued into the Old Assyrian period (Michel and Veenhof 2010), and are also recorded from Neo-Babylonian times (Oppenheim 1964:90; Bongenaar 1997). Workshops, and the storing of textiles in temple treasuries, have also been recorded from ancient Greece (Barber 1991:360). These activities are not necessarily cultic, but more likely an economic aspect of the temples. However, production of special kinds of textiles within the surroundings of a cult place is a different kind of activity and can point to weaving for the sanctuary.

The use of special fabrics for sacred or liturgical garments was, and still is, a common phenomenon all over the world. In Egypt a special kind of Egyptian linen was manufactured in the temples. This was 'royal linen' intended for priestly vestments and for clothing the divine statues (Hall 1986:18). The practice of clothing cult statues is also known from other countries in the eastern Mediterranean world (Oppenheim 1949:172-193). The ritual clothing of female and male images is an important and very old feature of Mesopotamian cults. The 'golden garments'[144] of the gods were the sacred vestments of the gods (Oppenheim 1949:172; Zawadzki 2006:74-79). Weaving clothes for the goddess is also attested from 6th-century Neo-Babylonian temple archives of southern Mesopotamia (Waerzeggers 2011:60), as well as from the archives of the Ebabbar temple in Sippar (Bongenaar 1997; Zawadzki 2006:23-14). In Greece, special coloured textiles were woven especially for the temples. The most famous case is that of the garment (*peplo*s) made at regular intervals to dress the statue of Athena Polias that stood in the Erechtheum on the Acropolis in Athens. During a procession, the garment was displayed to the public, being strung up like a sail on poles on top of a ship cart. The presentation of this garment is the subject of the great marble frieze around the Parthenon, where one can see the peplos being folded by a priest (Barber 1991:fig. 16.1). The peplos was just a little smaller than life-size, with intricate patterns in the weft. It was the duty of two of the child priestesses of Athena, the Arrephoroi, to help set up

[144] The garments were made of fine and shiny linen, and therefore were called golden garments.

the warp, while three priestesses, the Ergastinai, wove the garment on a warp-weighted loom. It took them nine months of full-time work to produce the peplos (Barber 1991:360-365).
Weaving for Asherah is mentioned in the Hebrew Bible (2 Kings 23:7). The weaving was undertaken by women in houses (*batim*) within YHWH's temple complex in Jerusalem. This demonstrates that weaving garments for Asherah was combined with the worship of YHWH, within a cultic setting and obviously in a public space.[145]

12.8 Conclusions

Was the production of textiles associated with cult, and if so, which deity was involved? Is it possible to answer this question based on the archaeological finds?
The finds from Tell Deir Alla and Kuntillet Ajrud show that two special kinds of textiles were produced there. Many small fragments of cloth have been found in Kuntillet Ajrud, mainly made from linen, whilst a very small part was made of a mixture of linen and wool (*shaatnetz*). Loom weights have been found at the site, confirming the idea that weaving took place within the settlement. The finds from Kuntillet Ajrud show that weaving was performed near the shrine. Since the texts mention Asherah as the sole female deity in the shrine, and weaving within cultic contexts has been associated with Asherah, it is possible that special fabrics were woven for the deity Asherah. At Deir Alla the output of weaving was more than the inhabitants could use themselves (Chapter 6). The surplus could have been used for exchange on the local market, but since a very special fabric (hempen cloth) was produced, part of the textile production may have been for the cult associated with the benched room in which the Balaam inscription was found. This cult room was possibly dedicated to the goddess Shagar, the main deity mentioned in the text. Cultic use could entail the production of liturgical garments, but also of garments meant for a statue of the deity.

Both at Deir Alla and at Kuntillet Ajrud, textiles were woven within a compound that yielded textual finds mentioning a goddess. The two female goddesses seem to represent the same mythological motif of a female deity symbolizing the feminine part of life. Deir Alla and Kuntillet Ajrud can be characterized as cultic sites. At both sites, the material culture shows that the weaving of special kinds of textiles played an important role within the settlement. The special kinds of textile produced at the site, hempen cloth in Deir Alla and cloth made of a mixture of wool and linen in Kuntillet Ajrud, was possibly meant to be used within the cult of the goddess, be her name Shagar or Asherah.

[145] Asherah is mentioned forty times in the Hebrew Bible. There is a discussion about whether Asherah is a word, a symbol, a tree, a pole or a deity (Lutzky1998; Wiggins 2001; Dever 2005).

Summary

The 1480 loom weights studied from four different sites in Transjordan prove that there are regional differences in their shape and use. There is a difference between the types used for a set of weights in Gilead and Moab compared to those from Ammon.
A comparison between the loom weights from the settlements in Gilead, the Jordan Valley and Moab also demonstrates that there is a striking difference in the size and weight of loom weights. In the Jordan Valley loom weights are larger and heavier than in the hill country of Gilead and Moab. This difference is related to the raw materials used. It is very likely that in the valley textiles mainly made of plant fibres were produced, such as linen and hemp, and in the mountainous regions mainly wool was produced. Plant fibres require heavier loom weights than wool. This pattern is similar to the situation in Cisjordan, where loom weights from the Shephelah are also heavier than those from the settlements in the hill country of Judea and Samaria (Shamir 2006).

Since no information was available about textile production and trade in the Iron Age in the Southern Levant, I went looking for an economic model for other kinds of artefacts. The model I used is by Van der Leeuw and it was developed for the production and distribution of pottery. This model was supplemented by written texts on trading textiles in the Old Assyrian period, as described by Veenhof and Michel (Veenhof 1972; Michel and Veenhof 2010). By combining the different data it was possible to create a new model for the production and distribution of textiles.

The relationship between textiles and cult was examined by means of a theoretical model based on the theories of Renfrew and Bahn (1991), Coogan (1987) and Zevit (2001), which opened up new insights on the material and the architecture of Khirbet al-Mudayna in Moab, and Deir Alla, Tell Mazar and Tell es-Saidiyeh in the Zerka Triangle in the Jordan Valley.

Khirbet al-Mudayna in Moab is a special place because there were only public buildings and all textile fragments, loom weights, spinning bobbins, dyes and limestone bins found were in or on the roofs of these buildings. Therefore, it is very likely that the textiles were intended for common use and/or profit. There was a weaving room in the temple complex and a connection with the cult is therefore very likely.
The walled settlement in the Wadi ath-Thamad yielded many unique discoveries, including pieces of textile, loom weights, spinning bobbins, spatulas and large limestone vessels. On one of those big basins motifs were incised: an animal, a palm tree and images resembling looms. Three altars were found in the temple of Mudayna, on one of which is an inscription. The altars were found together close to a limestone plateau in the temple. The temple is located directly behind the big six-chambered gate and is part of a temple complex with a cistern, a weaving room, a kitchen and a courtyard with ovens. The altar inscription is mounted on a tall, narrow conical altar made of limestone. The inscription reads ‘Incense altar made by Elishama for Josefa the daughter of Awat’. It is a unique inscription, firstly because for the first time it is clearly stated that the object is an incense altar. Until then, no one knew what such altars looked like. Secondly, the inscription on the altar tells us who the maker was. And thirdly, the altar was made for a woman. In addition, this woman is also referred to as the daughter of a person named Awat, which is most likely a woman’s name.
The temple complex of Khirbet al-Mudayna had a weaving room, a kitchen and a courtyard with ovens. This is a unique combination suggesting cooking, baking and weaving in association with the shrine. Textiles were probably produced to cover the needs of the temple, such as liturgical vestments. However, other woven products needed for worship, such as banners, flags, rugs and curtains, could also have been produced at the site. All the finds were unearthed in public buildings, such as a six-chambered gate and two large buildings with pillars. The architecture of these buildings is special. They consisted of three sections separated by two rows of pillars with

limestone basins in between. The floors of the aisles were paved and a thick layer of plaster had been applied around the bins. This kind of large public building with pillars was until recently considered to be exclusively Jewish, but apparently they were also used in Moab. Such a building has even been found in Ebla (Tell Mardikh) in Syria. In Ebla this building is regarded as a stable, an interpretation also advocated by some archaeologists for a similar building at Megiddo in Israel. For a long time this building was known as 'the stables of Solomon'. The remains of Khirbet al-Mudayna convincingly demonstrate that the tripartite pillared buildings at this site did not function as stables. Weaving was performed inside the buildings and on the roofs. The basins situated between the pillars were probably used for the tinting of fabrics. This is indicated by the thick layers of plaster on the structure around the basins between the pillars and the many free-standing limestone basins. One of these large limestone basins bore incised motifs depicting a palm tree, an animal and patterns suggesting the structure of looms. The various minerals that were found in the buildings and a pallet with copper residue were probably used for making paint. The textiles produced in this walled town on the plains of Moab were meant for common (public) use and/or benefit. Whether the weaving output outside the temple complex, in the large public buildings, had something to do with the temple is not clear. In any case, the textiles made at Khirbet al-Mudayna and the proceeds were not intended for private use.

In the central Jordan Valley, Deir Alla, Mazar and Saidiyeh can be seen as a row of sister sites, situated close to each other, whose fate was linked (Van der Steen 2013:81). Textile production in this part of the Jordan Valley was probably interconnected, each site making textiles on a different scale and producing various different types.
Large public buildings have been found in Mazar strata V and III (Iron Age), and in and around these buildings textiles were woven on a small scale. The production was limited and meant for the use of the inhabitants of the fort. Later in the Persian Period (Stratum II) there were no public buildings any more at Mazar. In this period private houses have been found, in which textiles were produced on a small scale. The small numbers of loom weights suggest that the production was intended for their own household use.

The southernmost of the three settlements was Deir Alla. In Iron IIB here, the production of textiles was three times more than in most of the other sites in the Southern Levant. It was a small, unwalled settlement, with the houses built close together around a temple complex. There were 24 looms found in 15 households, so more textiles were produced than the inhabitants needed for themselves. Because a specific fine hemp fabric was made at Deir Alla, and because most of the looms were used to weave patterns, the site can be described as specialised in producing local fine textiles. The shrine was a plastered benched room, on the wall of which was a long text about the seer Balaam and the disasters that he predicted. The finds and architecture reflect cultic use. The benched room was part of a cultic structure in which weaving and cooking were important activities. The fine hemp fabric made at Deir Alla indicates an exceptional production. The textile surplus was probably traded, but it is also possible that textiles were produced for the sanctuary.

A comparison between Deir Alla and Kuntillet Ajrud (Horvat Teman) shows that the finds, the texts and the architecture of both sites are similar. A special fabric was woven in both settlements – in Deir Alla hempen cloth, and in Kuntillet Ajrud linen and a mixture of linen with wool (*sha'atnetz*). In addition, texts have been found at both sites mentioning the name of a goddess; in Kuntillet Ajrud she is called Asherah, and in Deir Alla her name was Shagar.
Textile production at Deir Alla was high, which may have been due to the liturgical use of textiles in and associated with the temple, such as flags, banners, curtains or clothing, and possibly also clothes for the deity. It is also possible that textiles were traded through the temple. Given the exceptional quality of the hemp fabric and the fact that patterns were woven, the profits from the textiles from Deir Alla must have been relatively high.

Saidiyeh, the northernmost of the three sister sites, was a major settlement with rows of identical houses. Weaving was performed on a large scale (Pritchard 1985; Burke 2010). The architecture of the settlement and the finds, including hundreds of loom weights, exhibit a striking similarity to Gordion in Anatolia – which is dated to around 800 BC – where many loom weights and textile fragments have also been found. The textile fragments from Gordion resemble the pieces of fabric from Kuntillet Ajrud and Deir Alla. It is very likely that textiles were produced in Saidiyeh on an industrial scale. The settlement was probably a central place for textile production and trade within a network of cities situated in the central Jordan Valley east of the River Jordan.

The collection of loom weights, spindle whorls and spatulas from Tell er-Rumeith, located in the hill country of Gilead, is very small. Given the find spots of the material, weaving here was for personal use only. A cultic use could not be determined from the finds and the architecture of the site.

The approach of this study, placing textile research in the context of text analysis, has enabled new interpretations of archaeological finds, unveiling aspects of the economic, social and religious fabric of Iron Age society while simultaneously shedding new light on texts from the Southern Levant, resulting in a new kaleidoscopic approach to biblical archaeology.

Epilogue

Was Barber right when she stated that textile production was a time-consuming activity as quoted in the introduction to this book?

The time spent on making a garment is not easy to estimate, but it is definitely much more than most readers realize. There is an invisible factor in the following estimation regarding the time it took to become a skilled weaver. From Mesopotamian texts from Ur studied by Van der Mieroop (1997:187), it is known that it took five years for an apprentice weaver to learn the necessary skills.

-- How long did it take to produce yarn and textiles? --

It takes about eight hours to produce 100 g of yarn measuring 1150 m.[146]
One square meter of cloth (with a thread count of 10 threads/cm^2) requires 2 km of yarn (Anderson Strand 2010:12-13) requiring about 15 hours of spinning.
A garment requires about 1.5x5 meters of cloth, which means that about 122.5 hours of spinning are needed to produce the yarn to make a garment.
Setting up the loom and weaving the starting border takes about a week (7x8 = 56 hours).
Weaving a simple garment will take some 50 hours.

Thus spinning the yarn and weaving the cloth for a garment will take some 173+56 = 229 hours.
And finally, sewing the garment together will take some additional hours, ± 16.
Total: ± 245 hours of labour to produce a garment made of 1.5x5 m of cloth.

It should be realized that after the cloth was finished it also had to be trimmed and sewn, followed by some kind of finishing. In the case of linen and hemp the garment had to be pressed, and it was often pleated and pressed to produce garments as described above and depicted in figures 10.2 and 10.3. Some kinds of woollen cloth needed the additional treatment of fulling to eliminate oils, dirt and other impurities and to make the cloth thicker. The total amount of time spent on a garment was thus even more than the 245 hours of labour mentioned above.

The reconstruction of textile production from Iron Age Transjordan confirms the conclusions of Barber (Barber 1991:4) that the textile industry is a time-consuming activity and probably consumed far more hours of labour than pottery making and food production combined. Textile production was thus a major aspect of life in antiquity and deserves many hours of research and a permanent place in studies of the archaeology of the Southern Levant.

[146] The length of the spun yarn depends on the weight of the spindle whorl; the lighter the spindle, the thinner the thread, and thus the greater the length of yarn produced.

APPENDIX

Registration form for loom weights

Number:	Place:	Date:

Archaeological context

Field-number/square	Locus:	Excavation date:
Photograph no.	Drawing no.	Sample no.
Reg. no.		

State / Preparation

Group
O Isolated
O Storage
O Loom in function

Remarks: ---

Morphology

Type:			
Diameter:		Height:	Weight:
Complete O yes O no	Burnt O yes O no	Remarks:	

Perforation

Diameter:	Form:	Remarks:

Material

O Stone Remarks: O Clay Remarks:	Temper:

Dutch Summary

Ontrafelen van stof. Archeologisch onderzoek naar textielproductie in de IJzertijd van Transjordanië.

Dit proefschrift is de weerslag van onderzoek naar de productie van textiel in de IJzertijd (ca. 800 - 332 v. Chr.) in Transjordanië. Door het klimaat en de bodemgesteldheid wordt er maar zelden textiel gevonden, daarom zijn andere methodes nodig om te achterhalen wat voor textiel er werd gemaakt. De voorwerpen die werden gebruikt om draad te maken of om stof te weven worden vaak wel teruggevonden. Bij het spinnen gebruikte men spinklosjes, dat zijn kleine vliegwieltjes die de schacht van de spindel verzwaarden. Spinklosjes werden meestal gemaakt van steen, klei of van been en daardoor blijven ze bewaard en vormen zo een uniek archeologisch bewijs voor spinnen. Om een reconstructie te maken van wat er werd geweven zijn wat meer geluk en inventiviteit nodig, want het weefgetouw is meestal gemaakt van hout en dat wordt maar heel zelden teruggevonden. Maar er bestaat een artefact dat werd gebruikt om de scheringdraden op het weefgetouw aan te spannen, het weefgewicht. Weefgewichten werden gemaakt van steen of van klei. In de Levant komen weergewichten voor vanaf de Midden Bronstijd (2000-1500 v. Chr.), langzamerhand werden er steeds meer weefgewichten gebruikt en in de IJzertijd was er een spectaculaire toename van weefgewichten. Het gewichtengetouw werd intensief gebruikt tot in de Hellenistische periode, daarna -in de loop van de Romeinse tijd- werden er in de Levant geen weefgewichten meer gebruikt.

In de IJzertijd werden weefgewichten in de zuidelijke Levant meestal gemaakt van ongebakken klei, de gewichten werden geperforeerd en voorzien van een lus van stevig draad. Voor een getouw waren ongeveer 20-30 weefgewichten nodig. De scheringdraden werden bevestigd aan een van te voren geweven band die werd vastgemaakt aan een balk bovenaan het weefgetouw. De scheringdraden waren lang en hingen naar beneden, de draden werden met 10-20 tegelijk aan de lus van het weefgewicht bevestigd. Tijdens het weven konden de scheringdraden verlengd worden, zodat de stof net zo lang kon worden als men nodig had. Het gewicht van het weefgewicht bepaalde de spanning op de scheringdraden. De weefgewichten hingen in rijen onderaan het staande weefgetouw en het weefsel werd om de bovenste balk gewikkeld. Doordat de geweven stof bovenaan het getouw zat moest het weefsel van onder naar boven worden aangeslagen, daardoor stond degene die weefde voor het getouw. Het voordeel van deze manier van weven was de flexibiliteit van de scheringdraden, waardoor het gemakkelijker was om patronen te weven en doordat de scheringdraden tijdens het weven verlengd konden worden, had men de mogelijkheid om lange banen stof te weven. Weefgetouwen zijn lastig terug te vinden in een opgraving doordat hout, net als alle organisch materiaal, meestal vergaat. Maar doordat weefgewichten gemaakt werden van ongebakken klei, die soms werd gebakken in de brand die de nederzetting verwoestte, is het mogelijk de gewichtengetouwen van de IJzertijd terug te vinden. In dit onderzoek heb ik 1480 weefgewichten van vier verschillende opgravingen in Jordanië gebruikt als instrument om de productie van textiel zichtbaar te maken.

Het eerste hoofdstuk geeft een inleiding op de geschiedenis van het archeologisch onderzoek in de zuidelijke Levant, daarin wordt ook geschetst welke plaats de Bijbelwetenschap daarin heeft gespeeld. Daarna volgt een overzicht van archeologisch onderzoek naar weefgewichten in Transjordanië, gevolgd door de geschiedenis van dit gebied in IJzer II en in de Perzische periode (IJzer III). Het laatste deel van dit hoofdstuk belicht de rol van de Assyriërs in de geschiedenis van de Levant en toont aan dat hun invloed op de productie van textiel anders was dan men over het algemeen aanneemt. Door sommige auteurs wordt verondersteld dat de toename van weefgewichten veroorzaakt werd door een kwantitatieve toename van het weven. Zij veronderstellen dat er veel meer werd geweven omdat de inwoners van de zuidelijke Levant veel textiel moesten produceren als tribuut aan de Assyriërs. De toename van het aantal opgegraven

weefgewichten in de IJzertijd in de zuidelijke Levant is inderdaad een opvallend verschijnsel. Deze toename begint rond 850 v.Chr. en het aantal weefgewichten blijft constant in de daaropvolgende 300 jaar. De toegenomen hoeveelheid weefgewichten houdt derhalve geen verband met de komst van de Assyriërs in de 7e eeuw of met het tribuut dat de staten en stammen van de zuidelijke Levant aan hen moesten betalen (contra Browning 1988:154-158 en Kelm en Mazar 1995:163). De toename van het aantal weefgewichten heeft een andere oorzaak, en die valt af te leiden uit de positie waarin de weefgewichten worden gevonden. De weefgewichten van de IJzertijd liggen vaak in drie of meer rijen, dat duidt op het weven van patronen. De toename van het aantal weefgewichten wordt dus niet veroorzaakt door het gebruik van meer weefgetouwen maar door een weeftechnische innovatie, het weven van patronen.
Het weven van (gekleurde) patronen was een Levantijnse specialiteit die de Assyriërs waardeerden. Het tribuut bestond niet uit grote hoeveelheden textiel maar uit bijzondere lokale producten zoals voorwerpen van ivoor, fijn bewerkt hout, blauwe veren en lokale stoffen. Die stoffen worden genoemd in Assyrische tribuutlijsten en worden daar omschreven als *...de stoffen van hun land, gekleurde wol in rood, blauw en purper en ook linnen gewaden met gekleurde geweven wollen banden en wollen gewaden van rood purper*. Het tribuut bestond dus niet uit enorme hoeveelheden textiel, maar het ging de Assyriërs vooral om traditionele lokale gekleurde stoffen.

Dit boek bestaat uit drie delen. Deel één, dat zijn de hoofdstukken 2-5, daarin gaat het over de draden van het weefsel, het is een zoektocht naar textiel en textielproductie in de Levant. Deze hoofdstukken belichten de verschillende stadia van textielproductie, van ruwe grondstof via spinnen en weven tot het eindproduct, de stof. Draden en stoffen kunnen op verschillende manieren worden geverfd, over deze ingewikkelde chemische processen gaat deze studie niet, maar in hoofdstuk twee wordt wel een beknopt overzicht van verftechnieken en Levantijnse verfstoffen gegeven. Hoofdstuk 3 gaat over de geschiedenis van het weven en de ontwikkeling van het weefgetouw. Uit onderzoek naar weefgewichten blijkt, dat het gewichtengetouw een Neolithische innovatie was die ontstond in Centraal Europa en zich van daaruit in noordelijke en in zuidelijke richting verspreidde. De noordelijke route ging naar Scandinavië waar deze manier van weven in gebruik bleef tot in de vorige eeuw. Etnografisch onderzoek en documentatie van het weven in Noorwegen zijn van grote waarde geweest voor de reconstructie van weeftechnieken op het gewichtengetouw. De verspreiding via de zuidelijke route ging van Hongarije via Zwitserland, Italië, Griekenland, Cyprus naar Noord-Anatolië (Barber 1991). Lange tijd was niet duidelijk of het gewichtengetouw ook in Syrië en Zuid-Anatolië werd gebruikt. Uit opgravingen (Harrison 2009, Rahmstorf 2008, 2003 en Cechcini 2000) is gebleken dat er ook daar veel weefgewichten zijn gevonden uit de Brons- en IJzertijd. Dat verklaart het verschijnen van weefgewichten in de zuidelijke Levant. De bestudeerde weefgewichten uit de Jordaanvallei tonen duidelijke overeenkomsten in type en gewicht met de IJzertijd weefgewichten uit Syrië. Er blijkt een relatie te zijn tussen de Jordaanvallei en Aram, want ook in andere materiaalgroepen wordt een noordelijke invloed gevonden, zoals in benen spatula's, aardewerk en maalstenen (Petit 1999). Daarnaast worden door verschillende auteurs ook het schrift en de taal van de Bileam inscriptie uit Deir Alla gezien als een noordelijke variant van het Aramees (Lipiński 1994; Blum 2008).

Opgegraven weefgewichten vertonen allerlei beschadigingen waarvan niet direct duidelijk is of die veroorzaakt zijn door gebruik of door vervaardiging. Om te weten te komen welke sporen op weefgewichten te maken hebben met het maken van de gewichten en welke met het gebruik van weefgewichten, heb ik een experiment gedaan. Hoofdstuk 4 is een verslag van dat experiment. Het is een aardewerktechnisch onderzoek, volgens de Leidse traditie (Franken, Kalsbeek, Van As en Jacobs), dat wil zeggen dat het namaken van weefgewichten uitsluitsel zou kunnen geven over de manier waarop weefgewichten werden gemaakt. Bij aardewerkstudies is gebleken, dat door deze manier van werken het mogelijk is om een typologie te ontwikkelen die uitgaat van het materiaal en het maakproces en niet alleen van de vorm van een object. Door het maken van weefgewichten werd duidelijk dat bepaalde vormen gerelateerd waren aan de interactie tussen klei en de hoeveelheid water en magering die aan de klei werd toegevoegd. Vormen die oorspronkelijk ingewikkeld leken, bleken bijna als vanzelf te ontstaan door de manier waarop de klei in de hand gevormd werd. Maar het bleek verrassend moeilijk te zijn om een kogelrond weefgewicht te maken en goed te doorboren. Het drogen van dit balvormige weefgewicht bleek nog veel problematischer, want er ontstonden al gauw scheuren rondom de doorboring. Het bleek mogelijk te zijn om maaksporen te onderscheiden van gebruikssporen. Daardoor kon ik een basistypologie ontwikkelen voor weefgewichten. Vervolgens kon deze typologie gebruikt worden als uitgangspunt voor de studie naar vormverschillen in weefgewichten en voor een typologie van weefgewichten uit Transjordanië.

Het tweede deel van dit boek (hoofdstukken 6-9) gaat over het ontrafelen van de geheimen achter de archeologische vondsten. In dit gedeelte worden weefgewichten gebruikt als *research tool* om te reconstrueren waar en wat er werd geweven. Het is een verslag van het feitelijke onderzoek naar opgegraven materiaal van vier verschillende opgravingen in Transjordanië.
In hoofdstuk 6 worden de weefgewichten en textielvondsten van Tell Deir Alla in de Jordaanvallei gepresenteerd. In dit dorp werd intensief geweven, in sommige huishoudens waren meerdere weefgetouwen. Er werd in de huizen, op de binnenplaatsen en ook op de daken geweven. In deze nederzetting zijn een stukje textiel en wat draden gevonden, na analyse van dit materiaal bleek dat het gemaakt was van vezelhennep. Dat is bijzonder, want tot dan toe ging men er van uit dat henneptextiel alleen maar ten noorden van de Kaspische Zee en in Europa werd gebruikt en nooit in de Levant. Maar het blijkt dat men in de Jordaanvallei in ca. 800 v. Chr. een fijne stof maakte van vezelhennep. In de appendix bij dit hoofdstuk wordt aangetoond dat vezelhennep, net als vlas, heel goed in de Jordaanvallei verbouwd zou kunnen worden. Om te onderzoeken of deze activiteit ook zou passen in het leven van de bewoners van de Jordaanvallei in de IJzertijd heb ik een boerenkalender voor Deir Alla gemaakt. De Dier Alla kalender is gebaseerd op de *Gezer kalender* en botanische vondsten uit de IJzertijd, aangevuld met klimatologische gegevens en agrarische informatie met betrekking tot het verbouwen van vezelhennep. Het blijkt inderdaad mogelijk om in de Jordaanvallei vezelhennep te verbouwen.
Hoofdstuk 7 presenteert de weefgewichten van Tell Mazar, deze site ligt vlak bij Tell Deir Alla. Het materiaal komt uit alle lagen van de tel, van IJzertijd IIB (925-725 BC v. Chr.) tot in de Hellenistische periode (332-63 v. Chr.). Daardoor werd het mogelijk een diachrone typologie van weefgewichten uit de IJzertijd in Jordanië te maken. Hoofdstuk 8 gaat over Khirbet al-Mudayna in Moab, waar textiel, weefgewichten, spinklosjes, pigmenten en kalkstenen vaten werden gevonden die gebruikt werden in de textielproductie. Alle vondsten van deze tel komen uit openbare gebouwen, dat toont aan dat de productie bedoeld was voor gemeenschappelijk gebruik en/of profijt. In hoofdstuk 9 worden de vondsten van Tell er-Rumeith in het bergland van Gilead besproken. Het is een kleine collectie 10^{e}eeuws materiaal, de oudste uit deze studie en daarom belangrijk voor de typologie van weefgewichten. Dit materiaal bood ook de gelegenheid om een eerste verkennend onderzoek te doen naar de relatie tussen het gewicht van spinklosjes en weefgewichten in verband met het gebruik van wol of plantvezel.

In het derde en laatste deel van deze studie worden de feiten uit de voorgaande delen met elkaar verweven. De weefgewichten van de vier verschillende sites in Transjordanië tonen aan dat er regionale verschillen zijn. Er is verschil tussen de gebruikte types weefgewicht per set in Gilead en Moab ten opzichte van die uit Ammon. Uit een vergelijking tussen de weefgewichten uit de nederzettingen in Gilead, de Jordaanvallei en Moab blijkt dat er ook een opvallend verschil is in de maat en het gewicht van weefgewichten. In de Jordaanvallei zijn weefgewichten groter en zwaarder dan in het bergland van Gilead en Moab. Dit verschil houdt verband met de gebruikte van grondstoffen. Het is zeer waarschijnlijk dat er in de vallei vooral stof van plantvezels, zoals linnen en hennep, werd geproduceerd en in de bergstreken voornamelijk wol. Plantvezels vereisen zwaardere weefgewichten dan wol. Dit patroon is vergelijkbaar met de situatie in Cisjordanië, waar weefgewichten uit de Shephelah ook zwaarder zijn dan die van de nederzettingen in het gebergte van Judea en Samaria (Shamir 2006).

Omdat er over textielproductie en handel in de IJzertijd in de zuidelijke Levant geen informatie beschikbar is, ben ik op zoek gegaan naar een economisch model voor een andere artefactgroep. Het gebruikte model is van Van der Leeuw en het werd ontwikkeld voor de productie en distributie van aardewerk. Aangevuld met gegevens over de productie en handel in textiel zoals Veenhof en Michel die hebben beschreven voor de Oud-Assyrische periode (Veenhof 1972; Michel en Veenhof 2010), werd het mogelijk een nieuw model te maken om de productie en distributie van textiel te onderzoeken. De relatie tussen textiel en cultus wordt onderzocht doormiddel van een theoretisch model dat gebaseerd is op de theorieën van Renfrew en Bahn (1991), Coogan (1987) en Zevit (2001).

Khirbet al-Mudayna in Moab is een bijzondere plaats want er werden alleen maar openbare gebouwen gevonden en alle textielfragmenten, weefgewichten, spinklosjes, verfstoffen en kalkstenen bakken werden in of op de daken van deze gebouwen gevonden. Daarom is het zeer waarschijnlijk dat de textielproductie bedoeld was voor gemeenschappelijk gebruik en/of profijt. In het tempelcomplex is een weefkamer en een verband met de cultus is daardoor zeer waarschijnlijk.
De ommuurde nederzetting in de Wadi Thamad heeft veel unieke vondsten opgeleverd waaronder stukjes textiel, weefgewichten, spinklosjes, spatula's en grote kalkstenen vaten. Op een van die grote bakken werden ingekraste motieven, gevonden, een dier, een palmboom en afbeeldingen die lijken op weefgetouwen. In de tempel van Mudayna zijn drie altaren gevonden en op een van die altaren staat een inscriptie. De altaren werden bij elkaar gevonden op en net naast een kalkstenen plateau in de tempel. De tempel ligt direct achter de grote zeskamerpoort en is onderdeel van een tempelcomplex met een cisterne, een weefkamer, een keuken en een binnenplaats. De altaarinscriptie is aangebracht op een hoog en smal conisch altaar gemaakt van klaksteen. De inscriptie luidt: *Reukoffer altaar gemaakt door Elishama voor Josefa de dochter van Awa*t. Het is een unieke inscriptie, ten eerste omdat er voor het eerst duidelijk aangegeven wordt dat het voorwerp een reukofferaltaar is. Tot dan toe wist niemand hoe zo'n ding eruit zag. Ten tweede staat er op dat altaar wie de maker is. En ten derde blijkt dat het altaar voor een vrouw werd gemaakt. Daarnaast wordt die vrouw ook nog aangeduid als de dochter van een persoon met de naam Awat, wat zeer waarschijnlijk ook een vrouwennaam is.
Het tempelcomplex van Khirbet al-Mudayna had een weefkamer, een keuken en een binnenplaats met ovens. Dat is een unieke combinatie die doet vermoeden dat er voor de tempel werd gekookt, gebakken en geweven. Bij het weven zou het kunnen gaan om het maken van liturgische gewaden, maar het zou ook heel goed kunne gaan om andere geweven producten die nodig waren in de eredienst, zoals banieren, vlaggen, kleden en gordijnen. Op andere plaatsen in de nederzetting werden ook weefgewichten, spinklosjes en spatula's gevonden. Al deze vondsten werden opgegraven in openbare gebouwen, zoals een zeskamerpoort en twee grote gebouwen met pilaren. De architectuur van deze gebouwen is bijzonder. In de gebouwen stonden twee rijen pilaren met daartussen kalkstenen bakken die de ruimte in drieën verdeelden. De vloer van de zijbeuken was geplaveid en rondom de bakken was een dikke laag pleister aangebracht. Dit soort grote openbare gebouwen met pilaren werd tot voor kort als exclusief Israëlitisch beschouwd, maar blijkbaar komen ze ook in Moab voor. Er is zelfs een dergelijk gebouw gevonden in Ebla (Tell Mardikh) in Syrië. In Ebla wordt dit gebouw gezien als een stal, een functie die door sommige archeologen ook wordt bepleit voor een dergelijk gebouw in Megiddo in Israël. Lange tijd stond het bekend als de *stallen van Salomo*. Uit de vondsten in Khirbet al-Mudayna blijkt dat deze *tripartite pillared buildings* in deze nederzetting niet als stallen functioneerden. In de gebouwen en ook op het dak werd geweven en in de bakken tussen de pilaren werd waarschijnlijk stof geverfd. Dat blijkt uit de dikke lagen pleister op de constructie rondom de bakken tussen de pilaren, de vele kalkstenen bakken die niet in de architectuur waren ingebouwd, zoals de grote bak met de ingekraste motieven. De verschillende mineralen die in de gebouwen werden gevonden en een pallet met koperresidu werden waarschijnlijk gebruikt voor het maken van verf. De productie van textiel in dit ommuurde stadje op de vlakte van Moab was bedoeld voor gemeenschappelijk (openbaar) gebruik en/of profijt. Of de productie buiten het tempelcomplex, in de grote openbare

gebouwen, ook iets met de tempel te maken had, is niet duidelijk. De textielproductie en de opbrengst daarvan waren in Khirbet al-Mudayna in ieder geval niet bedoeld voor privé gebruik.

In de centrale Jordaanvallei worden Deir Alla, Mazar en Saidiyeh gezien als een rij zustersites die vlak bij elkaar lagen en wier lot met elkaar verbonden was (Van der Steen 2013:81). De productie van textiel in deze regio was waarschijnlijk op elkaar afgestemd, waardoor de nederzettingen op verschillende schaal diverse soorten textiel produceerden.
In Mazar Stratum V en III (IJzertijd) werden grote openbare gebouwen gevonden, in de huizen rondom deze gebouwen werd op kleine schaal geweven, men maakte eenvoudige stoffen maar ook stof met patronen en waarschijnlijk werd er ook stof geverfd. De productie was voor eigen gebruik. In de Perzische periode (Stratum II) waren er op Mazar geen openbare gebouwen meer, er zijn huizen gevonden en er werd op kleine schaal textiel geproduceerd. De kleine hoeveelheden doen vermoeden dat de productie bedoeld was voor eigen huishoudelijk gebruik.
De zuidelijkste van de drie nederzettingen was Deir Alla. In IJzer IIB was hier de productie van textiel drie keer zo hoog als in de meeste andere sites in de zuidelijke Levant. Het was een kleine nederzetting gebouwd rondom een tempelcomplex. Er werden 24 weefgetouwen gevonden in 15 huishoudens, men weefde dus meer dan men zelf nodig had. Omdat er een bijzondere fijne stof van vezelhennep werd gemaakt en omdat de meeste weefgetouwen werden gebruikt om patronen te weven kan de productie omschreven worden als specialistisch.
Op een gepleisterde muur in Deir Alla is een lange tekst gevonden waarin wordt verteld over de ziener Bileam en de rampen die hij voorspelde. De kamer met de Bileam inscriptie, heeft de eigen schappen van een tempel, de vondsten en de architectuur wijzen op cultisch gebruik. In de gebouwen van het tempelcomplex werd geweven, graan gemalen, gebakken en gekookt. Het kan zijn dat het surplus verhandeld werd, maar het is ook mogelijk dat er (ook) werd geweven voor het heiligdom. Het feit dat hier fijne hennepstof werd gemaakt, duidt op een uitzonderlijke productie. Een vergelijking met Kuntillet Ajrud (Horvat Teman) in de Sinaï-woestijn toont aan dat zowel de vondsten als de architectuur van beide sites overeenkomsten vertonen. In beide nederzettingen werd een aparte stof geweven, in Deir Alla hennep stof en in Kuntillet Ajrud was dat linnen en een mengsel van linnen met wol (*sha'atnetz*). Daarnaast werden er op beide sites teksten gevonden die de naam van een godin noemen, in Kuntillet Ajrud heette zij Asherah en in Deir Alla was haar naam Shagar.
De textielproductie in Deir Alla was hoog, dit kan te maken hebben gehad met gebruik van textiel in de tempel. Dan valt te denken aan (liturgisch) gebruik van vlaggen, banieren, gordijnen of kleding, maar ook aan kleding voor het godenbeeld. Het is ook mogelijk dat er werd geweven voor handel via de tempel. Gezien de kwaliteit van de uitzonderlijke hennepstof en het feit dat er patronen werden geweven zal de opbrengst van de textiel in Deir Alla hoog geweest zijn, voor wie die stof dan ook bedoeld was.
Saidiyeh, de noordelijkste van de drie zustersites, was een grote plaats waar in rijen identieke huizen op grote schaal werd geweven (Pritchard 1985; Burke 2010). De architectuur van deze nederzetting en de vondsten, waaronder honderden weefgewichten, vertonen een treffende overeenkomst met Gordion in Anatolië. In Gordion, dat gedateerd wordt rond 800 v. Chr., werden ook veel textielresten gevonden. Deze textielfragmenten lijken op de stukjes stof uit Kuntillet Ajrud en Deir Alla. Het is zeer waarschijnlijk dat er in Saidiyeh op industriële schaal werd geweven en dat deze nederzetting een belangrijke plaats was voor textielproductie binnen het netwerk van steden in de centrale Jordaanvallei ten oosten van de Jordaan.[147]

De collectie weefgewichten, spinklosjes en spatula's van Tell er-Rumeith in het bergland van Gilead is erg klein, gezien de vindplaatsen weefde men alleen voor eigen gebruik. Uit de vondsten en de vindplaatsen kon een cultisch gebruik niet worden vastgesteld.

[147] De vondsten van Tell es-Saidiyeh liggen in het Brits Museum in Londen en zijn nog niet gepubliceerd. In een vervolgonderzoek zou dit materiaal duidelijkheid kunnen geven over de organisatie van de textielproductie en de relaties tussen de verschillende sites in de Jordaanvallei.

Tenslotte wordt er in de epiloog een indicatie gegeven over de tijd die het vergt om een bepaalde hoeveelheid textiel te produceren. Spinnen en weven zijn erg arbeidsintensief. Om ongeveer een uur te weven is er eerst 7-10 uur gesponnen. Het kost meer dan 245 uur (spinnen, weven en naaien samen) om een bovenkleed (1.5x5 meter stof) te maken. Hieruit blijkt dat het inderdaad heel veel tijd kostte om textiel te maken. Ik ben het met Barber (1991) eens dat in de oudheid de leden van een huishouden evenveel tijd moesten besteden aan het maken van textiel (spinnen, weven en naaien) als aan broodbakken, koken en pottenbakken samen.

In deze studie werden 1480 weefgewichten en de architectuur van vier verschillende opgravingen in Transjordanië onderzocht. Daardoor werd het mogelijk om een reconstructie te maken van de geweven stof en de economische en sociale aspecten van textielproductie. Het tekst materiaal van de opgravingen werd bestudeerd en de resultaten werden vervolgens godsdiensthistorisch onderzocht. Het blijkt dat in de IJzertijd bij textielproductie in Ammon en Moab cultische factoren een rol speelden en dat er soms geweven werd voor een godin.

Een caleidoscopische benadering, zoals toegepast in deze studie, waarin zowel artefacten, architectuur als teksten van een opgraving in context worden bestudeerd, opent nieuwe mogelijkheden voor de interpretatie van zowel het archeologische materiaal als van de teksten. Daardoor wordt het mogelijk een realistischer beeld te schetsen van de sociale, economische en religieuze facetten van de zuidelijke Levant gedurende de IJzertijd.

Abbreviations

AASOR	Annual of the American Schools of Oriental Research
ICAANE	International Congress on the Archaeology of the Ancient Near East
ASOR	American Schools of Oriental Research
ADAJ	Annual of the Department of Antiquities of Jordan
AJA	American Journal of Archaeology
ARA	Annual Review of Anthropology
APEF	Annual of the Palestine Exploration Fund
AOAT	Alter Orient und Altes Testament
BA	Biblical Archaeologist
BAR	Biblical Archaeology Review
BASOR	Bulletin of the American Schools of Oriental Research
BN	Biblische Notizen
CA	Current Anthropology
EAEHL	Encyclopedia of Archaeological Excavations in the Holy Land
NEAEHL	New Encyclopedia of Archaeological Excavations in the Holy Land
IEJ	Israel Exploration Journal
ICHAJ	International Conference on the History and Archaeology of Jordan
JBL	Journal of Biblical Literature
JCS	Journal of Cuneiform Studies
JNES	Journal of Near Eastern Studies
MDOG	Mitteilungen der Deutschen Orient-Gesellschaft zu Berlin
MNDPV	Mitteilungen und Nachrichten des Deutschen Palästina Vereins
NEA	Near Eastern Archaeology
PEQ	Palestine Exploration Quarterly
PEFQS	Palestine Exploration Fund, Quarterly Statement
RB	Revue Biblique
SHAJ	Studies in the History and Archaeology of Jordan
TA	Tel Aviv
UF	Ugarit Forschungen
UTM	Universal Transverse Mercator geographic coordinate system
VT	Vetus Testamentum
WA	World Archaeology
ZAW	Zeitschrift für die alttestamentliche Wissenschaft
ZDPV	Zeitschrift des Deutschen Palästina-Vereins

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